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ABSTRACT

"Future Scenarios in Communications" is one of the "Preparing for Tomorrow's World" (PTW) program modules. PTW is an interdisciplinary, future-oriented program incorporating information from the sciences and social sciences and addressing societal concerns which interface science/technology/society. The program promotes responsible citizenry with increased abilities in critical thinking, problem-solving, social/ethical reasoning, and decision-making. Compared in this module (for students in grades 7-8) is the development of two communications systems, past and future, and their impact on changes in life-styles. The module is comprised of two sections, the first examining development of the telephone system in the United States and the second examining the development and applications of the computer. Futures forecasting techniques (Delphi probe, trend analysis, cross-impact analysis, scenario writing) are used in both sections. The teaching guide includes a discussion of the socio-scientific reasoning model (theoretical basis of the PTW), module overview (purpose; strategies employed; module structure/objectives; and its use in the school curriculum), and suggested instructional strategies. A bibliography and list of Kohlberg's stages of moral development are included. The module may be used as a separate unit of study, as a mini-course, or incorporated into social studies, language arts, history, or general science courses. (JN)

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PREPARING FOR TOMORROW'S WORLD

Future Scenarios in Communications

Teacher's Guide

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Preparing for Tomorrow's World
An Interdisciplinary Curriculum Program

Coastal Decisions: Difficult Choices
Energy: Decisions for Today and Tomorrow
Future Scenarios in Communications
Space Encounters
Technology and Changing Life-Styles
Food: A Necessary Resource
Perspectives on Transportation
Future New Jersey: Public Issues and the Quality of Life
People and Environmental Changes
Environmental Dilemmas: Critical Decisions for Society
Of Animals, Nature and Humans
Beacon City: An Urban Land-Use Simulation
Dilemmas in Bioethics
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PREPARING FOR TOMORROW'S WORLD

Future Scenarios in Communications

Teacher's Guide

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PREFACE

We live in an exciting, rapidly changing, and challenging world—a world highly dependent upon science and technology. Our world is changing so rapidly that we sometimes fail to recognize that much of what we today take for granted as common, everyday occurrences existed only in the imaginations of people just a few short years ago. Advances in science and technology have brought many dreams to fruition. Long before today's school children become senior citizens, much of today's "science fiction" will, in fact, become reality. Recall just a few accomplishments which not long ago were viewed as idle dreams:

- *New biomedical advances have made it possible to replace defective hearts, kidneys and other organs.*
- *The first air flight at Kitty Hawk lasted only a few seconds. Now, a little over half a century later space ships travel thousands of miles an hour to explore distant planets.*
- *Nuclear technology—of interest a few short years ago because of its destructive potential—could provide humankind with almost limitless supplies of energy for peace-time needs.*
- *Computer technology has made it possible to solve in seconds problems which only a decade ago would require many human lifetimes.*
- *Science and technology have brought us to the brink of controlling weather, earthquakes and other natural phenomena.*

Moreover, the changes which we have been experiencing and to which we have become accustomed are occurring at an increasingly rapid rate. Changes, most futurists forecast, will continue and, in fact, even accelerate as we move into the 21st Century and beyond. But, as Barry Commoner has stated, "There is no such thing as a free lunch." These great advances will not be achieved without a high price. We are now beginning to experience the adverse effects of our great achievements:

- *The world's natural resources are being rapidly depleted.*
- *Our planet's water and air are no longer pure and clean.*
- *Thousands of plant and animal species are threatened with extinction.*
- *Nearly half the world's population suffers from malnutrition.*

While science and technology have given us tremendous power, we are also confronted with an awesome responsibility: to use the power and ability wisely, to make equitable decision tradeoffs, and to make valid and just choices when there is no absolute "right" alternative. Whether we have used our new powers wisely is highly questionable.

Today's youth will soon become society's decision-makers. Will they be capable of improving upon the decision-making of the past? Will they possess the skills and abilities to make effective, equitable, long-range decisions to create a better world?

To the student:

This module has been prepared to help you—the student and future decision maker—function more effectively in a rapidly changing world. Other modules in the *Preparing for Tomorrow's World* program focus on additional issues of current and future importance.

To the teacher:

It is our belief that this module—and indeed the entire *Preparing for Tomorrow's World* program—will help you the teacher prepare the future decision-maker to deal effectively with issues and challenges at the interfaces of science/technology/society. It is our belief that the contents and activities in this program will begin to prepare today's youth to live life to the fullest, in balance with Earth's resources and environmental limits, and to meet the challenges of tomorrow's world.

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INTRODUCTION

"To avert future shock, we must create a super-industrial education system. And to do this, we must search for our objectives and methods in the future, rather than in the past."

Alvin Toffler
Future Shock

Alvin Toffler, in his book *Future Shock*, focuses attention on change — on its rapidly accelerating pace and its impact on our lives. He documents the development of a unique phenomenon where individuals are overwhelmed by too much change in too short a period of time. This "future shock" produces stress and disorientation. As a partial antidote, Toffler suggests that we make a concerted effort to speculate on the nature of alternative futures that we may confront.

Philip Wendall in *Learning for Tomorrow* emphasizes the point that, "The imagining of possible futures is now fundamental both to the process of personal growth and to the development of a world consciousness . . . With new technologies rapidly and radically reshaping the entire society. . . role definitions are no longer stable. Roles for young people and the very context in which roles are defined are likely to be more different than the same in the future."[1]

Toffler and others[2] would have us reorient the educational process. Rather than direct the attention of students to the past with its outmoded facts, lifestyles and methods for solving societal problems, these futurists would encourage students to contemplate the dilemmas and opportunities of the future. Through this process students will be able to weigh the advantages and disadvantages of possible alternative futures and define one or more preferable future scenarios.

In accord with this philosophy this module is designed to introduce students to some forecasting techniques used to investigate the future and to provide sufficient background information to allow them to develop future scenarios. It should be made clear at the outset that the module emphasizes the *techniques* of future projection. The module is not designed to yield predictions with high degrees of accuracy. As economists and other social scientists have amply demonstrated, it is extremely difficult to make precise predictions of human systems for even short periods of time.

However, the future cannot be ignored because we are unable to perceive it with precision. By the same token, the past should not be studied exclusively simply because it is known with certainty. As the approach in this module demonstrates, we can examine the future in relation to social and technical trends established in the past and arrive at a range of alternative scenarios which may come to pass.

[1] Philip Wendall. Futurism and the reform of higher education. In *Learning for tomorrow*, Alvin Toffler (Ed.), Vintage Books: New York, 1974, p. 290.

[2] Wendall Bell. Social science: the future as a missing variable, and Shane, H.G. and J.G., Educating the youngest for tomorrow, in *Learning for tomorrow*, Alvin Toffler (Ed.), Vintage Books: New York, 1974.

The Theoretical Basis of *Preparing for Tomorrow's World:*

The Socio-Scientific Reasoning Model

As pointed out in the Introduction to this guide, developments in science and technology are not without societal issues and problems. New developments and applications will inevitably bring about new issues as well as increase their complexity. Unlike scientific problems, socio-scientific problems often have no "correct" answer because they involve human choices and decisions. Such choices and decisions are value ladened. The particular decisions made today and tomorrow will determine the course of the future. Hence, we are faced with the profound challenge to make just and wise decisions in order to create a better future world. To help prepare our students to become more effective problem solvers and decision makers, education will need to focus on the simultaneous development of the following skills:

- Ability to deal with problems containing multiple interacting variables
- Decision making that incorporates a wider social perspective
- Critical thinking in the evaluation of consequences and implications

Components of the Socio-Scientific Reasoning Model

In response to the above concern and recognizing the importance of this mode of development, we developed the "socio-scientific reasoning" model to serve as a framework in the production of our curriculum materials. This model combines our own philosophy, ideas and research with the theories and philosophies of Piaget, Dewey, Kohlberg and Selman. Basic to these theories is the idea of education as helping an individual grow both intellectually and morally. Therefore, this socio-scientific reasoning model approaches education from a developmental perspective. This model incorporates the ideas of stage development from the perspective of cognition, moral/ethical reasoning and social role taking. The basic tenets of these theories are briefly summarized below.

Logical Reasoning

Jean Piaget, the noted Swiss psychologist, has made important contributions in the area of cognitive development which are pertinent to our efforts[1,2]. Piaget views the development of logical reasoning as progression through the series of stepwise stages indicated in Table I (sensori-motor, preoperational, concrete operational and formal operational). At each successive stage the logical reasoning ability of individuals takes on a broader perspective and incorporates the ability to deal with greater numbers of interacting variables of increasing intellectual complexity. Each stage of thinking builds upon the previous one, but takes on a new structural form. Growth in cognition, it seems, can be facilitated and nurtured through appropriate educational experiences.

In explaining growth in logical reasoning capability, Piaget refers to the processes of assimilation, accommodation, and equilibration. Assimilation occurs when the child incorporates new ideas and situations into his or her existing thought structures. On the other hand, the child also encounters objects and events that do not fit into his or her existing thought structures. In these contradictory situations, the child has essentially two options: he/she must either enlarge his/her existing structures or create a new category or structure. Piaget defines this as the process of accommodation.

Intellectual growth, Piaget postulates, occurs when the individual attempts to resolve the tension between the interactive processes of assimilation and accommodation by developing new thoughts and responses that are more suitable or adequate. Equilibrium is re-established when thought structures are altered, producing new accommodations that enable the individual to assimilate the new situations. Intellectual growth, then, occurs through internal self-regulation processes that lead to new, higher levels of equilibration.

Moral/Ethical Reasoning

While there are several approaches to values education, the more encompassing one is the cognitive developmental approach offered by Lawrence Kohlberg[3,4]. Kohlberg's ideas are derived from the philosophic positions of Dewey and and Piaget. The emphasis here is to help individuals grow intellectually and morally. This is, we feel, a more functional approach than arbitrary indoctrination of values as used in "character" or "socialization" education or taking a "values relativity" stance, typically employed in the more common values clarification approach.

Kohlberg's moral/ethical development theory is an extension of Piaget's cognitive development theory. Similarly to Piaget, Kohlberg views moral development from childhood to adulthood as progression through a series of stages (Table 2). Each stage is characterized by a very different way of perceiving and interpreting one's experiences. At Kohlberg's Stage 2, for example, "right" and "wrong" are judged in terms of satisfying one's own needs and sometimes the needs of others if it is convenient to do so. Stage 3 type of reasoning centers around maintenance of approval in one's own social group. The orientation is towards conformity to group expectation. At the higher principled stages, reasoning takes into account concerns for the welfare of others in a broader context, and includes concerns for human dignity, liberty, justice, and equality—those very same principles upon which our Constitution is based.

Following Piaget, Kolhberg views development not as mere accumulation of information, but changes in thinking capabilities—the structures of thought processes. In the course of development, higher-level thought structures are attained and result in the extension of an individual's social perspective and reasoning capabilities. Applying higher levels of thinking to problems results in problem solutions that have greater consistency and are more generalizable. See Appendix detailing the stages of development.

Social Role-Taking Stages

The research of Robert Selman[5] indicates that social role taking ability is a developed capacity which also progresses in a series of stages from early childhood through adolescence. Role taking is viewed by Selman in terms of qualitative

changes in the manner a child structures his/her understanding of the relationship between the perspectives of self and others.

Using the open-ended clinical method of inquiry first applied by Piaget and then later by Kohlberg, Selman has identified and defined Stages 0 through 4 (age range is approximately 3 years to 15+ years). These stages are referred to as: Ego-centric Viewpoint (Stage 0), Social-Informational Role Taking (Stage 1), Self Reflection Role Taking (Stage 2), Mutual Role Taking (Stage 3), and Social and Conventional System Role Taking (Stage 4). Descriptions of the role taking stages appear in Table 3. Each of Selman's role taking stages relates closely to and parallels Kohlberg's moral reasoning stages.

Selman views the social role taking stages as a link between Piaget's logical reasoning stages and Kohlberg's moral reasoning stages. Just as Piaget's logical reasoning stages are necessary but not sufficient for attaining the parallel moral reasoning stages, a similarly necessary but not sufficient relationship appears to exist between the social role taking stages and parallel moral reasoning stages.

As Selman has pointed out, ". . .the child's cognitive stage indicates his level of understanding of physical and logical problems, while his role taking stage indicates his level of understanding of the nature of social relations, and his moral judgment stage indicates the manner in which he decides how to resolve social conflicts between people with different points of view".

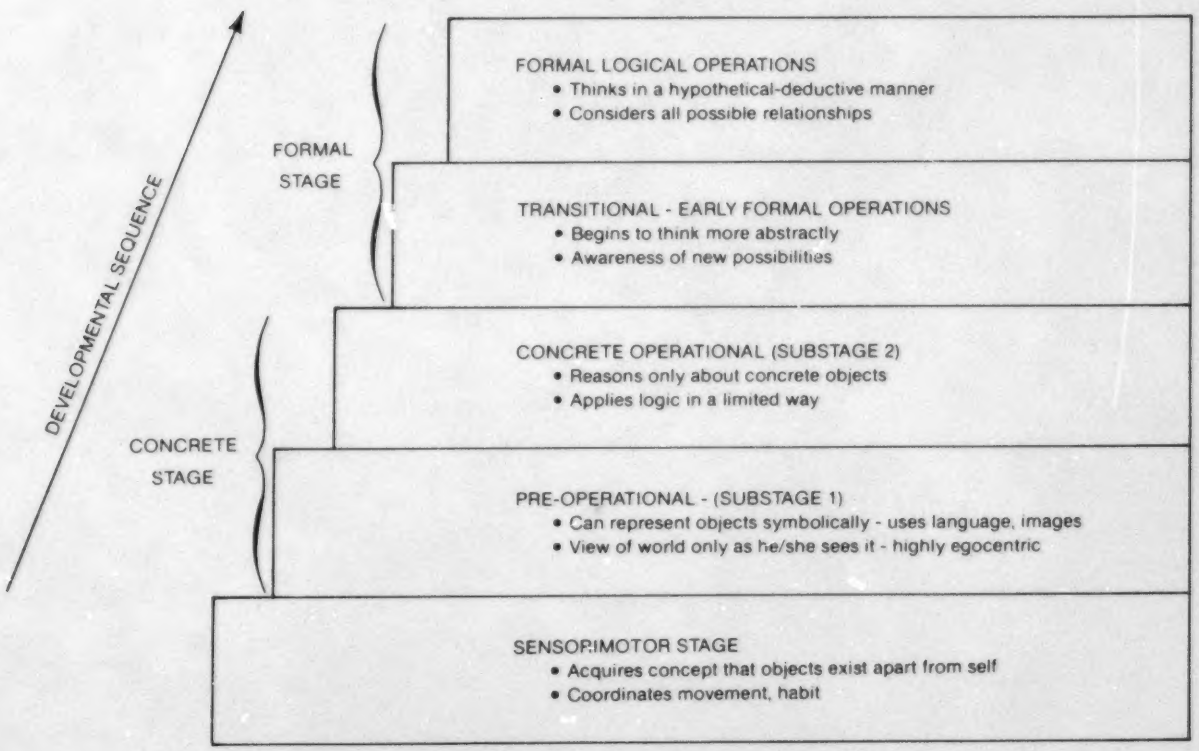
The Socio-Scientific Reasoning Model

Combining our own philosophy, ideas, and research with the theories of Piaget, Kohlberg and Selman, the socio-scientific reasoning model has been developed. Socio-scientific reasoning, as defined here, is the incorporation of the hypothetico-deductive mode of problem solving with the social and moral/ethical concerns of decision making. This model has served as a guide in the development of educational materials to help students advance to higher levels of thinking and reasoning capabilities. Moreover, it is highly flexible and readily adaptable to other classroom activities.

The basic assumption of this model is that effective problem solving requires simultaneous development in the realms of logical reasoning, social role taking, and moral/ethical reasoning. Purely objective scientific thinking cannot be applied in the resolution of most of the probable future conflicts without regard to the impact of those decisions on human needs and human goals. A technological solution, for example, may be, after critical analysis, feasible and logically consistent. From a societal perspective, however, one must question whether or not it should be applied. How to best prioritize our needs and evaluate trade-offs with a concern for the needs of future generations involves logical reasoning and critical thinking, but now with an added dimension . . . a social moral/ethical reasoning dimension.

Hence, the Socio-Scientific model consists of four interacting components (see Figure 1): (1) logical reasoning develop-

TABLE 1
PIAGET'S STAGES OF COGNITIVE DEVELOPMENT


DEVELOPMENTAL SEQUENCE
FORMAL STAGE
CONCRETE STAGE
FORMAL LOGICAL OPERATIONS
• Thinks in a hypothetical-deductive manner
• Considers all possible relationships
TRANSITIONAL - EARLY FORMAL OPERATIONS
• Begins to think more abstractly
• Awareness of new possibilities
CONCRETE OPERATIONAL (SUBSTAGE 2)
• Reasons only about concrete objects
• Applies logic in a limited way
PRE-OPERATIONAL - (SUBSTAGE 1)
• Can represent objects symbolically - uses language, images
• View of world only as he/she sees it - highly egocentric
SENSORIMOTOR STAGE
• Acquires concept that objects exist apart from self
• Coordinates movement, habit

ment is based on the theories of Piaget, while (2) moral/ethical reasoning relies strongly on Kohlberg's ideas. Selman's research provides the basis for the third component, the social role taking aspects of our model. Since the content or information component of the problem (component four) will vary, so too will the concepts vary accordingly. For example, in our applications of this model we have concentrated on issues at the interfaces of science, technology, and society. Of course, problem issues could also deal with or focus on any other topic one chooses to investigate.

The content component also consists of three interacting subunits. These subunits—science, technology, and society—rely on each other for their very existence. While each of the subunits is dependent upon the others, their individual underlying value structures create a high potential for discord since the concerns of one subunit often conflict with those of the

TABLE 2
KOHLBERG'S STAGES OF MORAL DEVELOPMENT

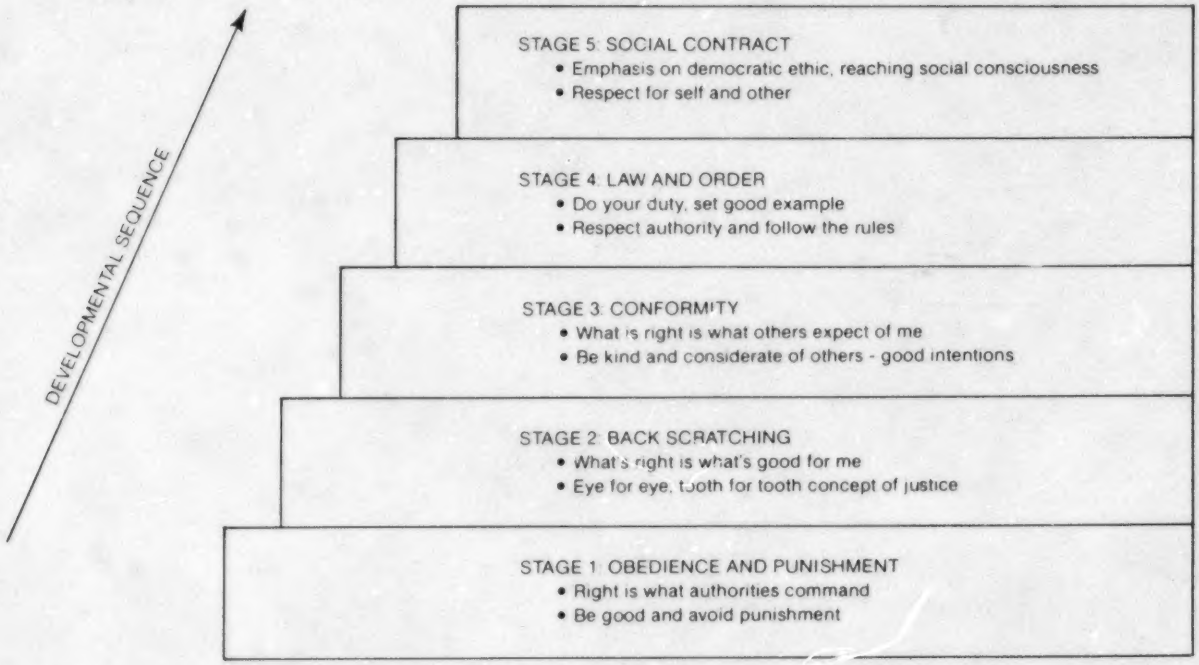

DEVELOPMENTAL SEQUENCE
STAGE 5: SOCIAL CONTRACT
• Emphasis on democratic ethic, reaching social consciousness
• Respect for self and other
STAGE 4: LAW AND ORDER
• Do your duty, set good example
• Respect authority and follow the rules
STAGE 3: CONFORMITY
• What is right is what others expect of me
• Be kind and considerate of others - good intentions
STAGE 2: BACK SCRATCHING
• What's right is what's good for me
• Eye for eye, tooth for tooth concept of justice
STAGE 1: OBEDIENCE AND PUNISHMENT
• Right is what authorities command
• Be good and avoid punishment

TABLE 3
SELMAN'S ROLE-TAKING STAGES

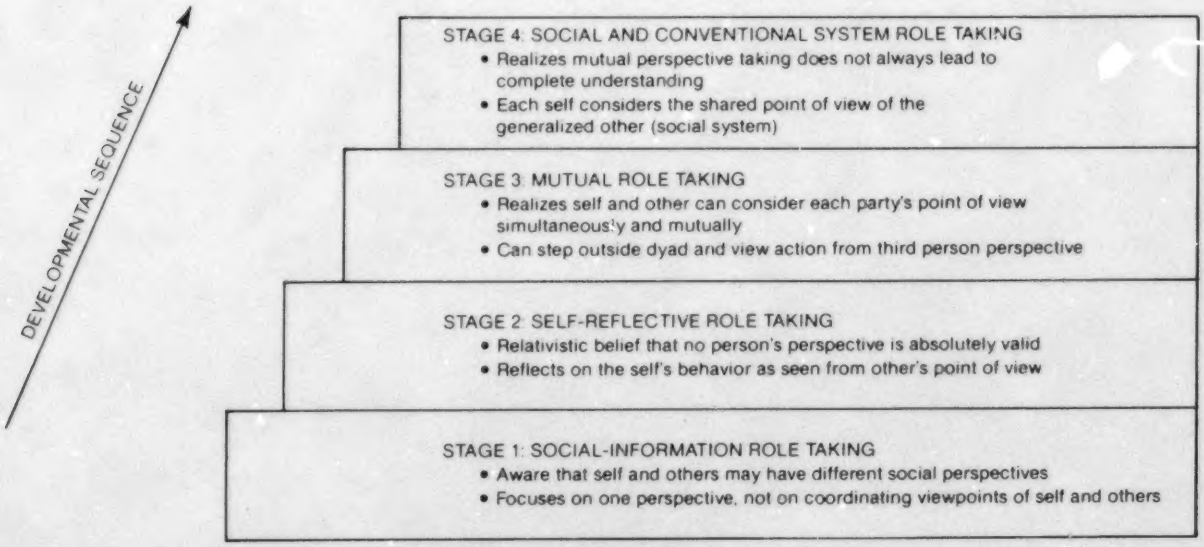
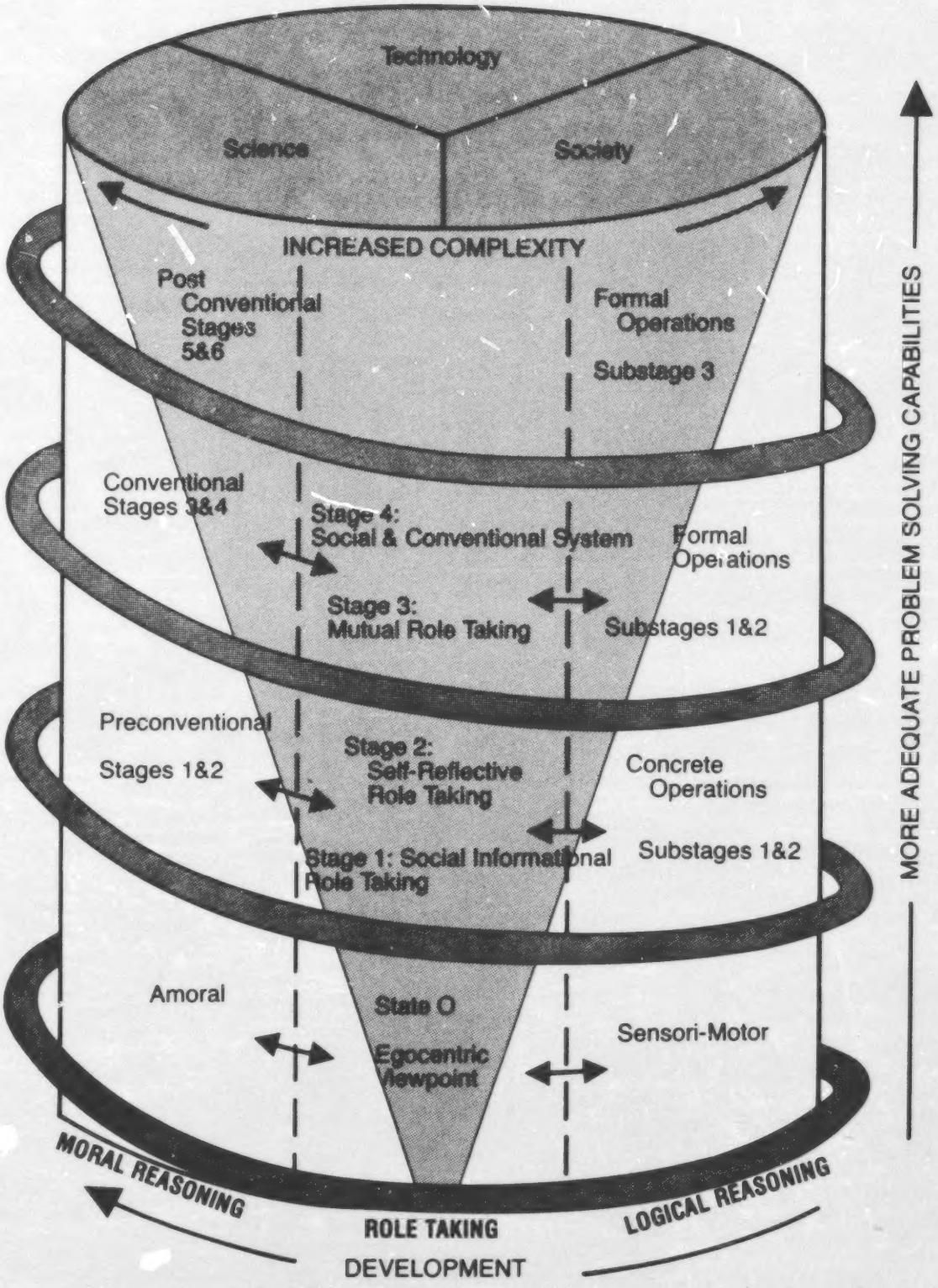

DEVELOPMENTAL SEQUENCE
STAGE 4: SOCIAL AND CONVENTIONAL SYSTEM ROLE TAKING
• Realizes mutual perspective taking does not always lead to complete understanding
• Each self considers the shared point of view of the generalized other (social system)
STAGE 3: MUTUAL ROLE TAKING
• Realizes self and other can consider each party's point of view simultaneously and mutually
• Can step outside dyad and view action from third person perspective
STAGE 2: SELF-REFLECTIVE ROLE TAKING
• Relativistic belief that no person's perspective is absolutely valid
• Reflects on the self's behavior as seen from other's point of view
STAGE 1: SOCIAL-INFORMATION ROLE TAKING
• Aware that self and others may have different social perspectives
• Focuses on one perspective, not on coordinating viewpoints of self and others

FIGURE 1

THE SOCIO-SCIENTIFIC REASONING MODEL



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others. This paradox—dependence and simultaneous conflict among the subunits—presents a unique opportunity and context for curriculum developers employing the Socio-Scientific Reasoning model to prepare educational materials.

Each component of this model is not seen as a totally separate and distinct entity. Rather, each of the four components interacts with and has an effect on all other components. Thus, logical reasoning has an effect on, and in turn is affected by, social role taking development. In a similar manner, social role taking has an effect on, and is affected by, developments in the moral/ethical realm. Of course, logical reasoning and moral/ethical reasoning also interact. Each of these major components—logical reasoning, social role taking, and moral/ethical reasoning—interact not only with each other but with the fourth component, content or information.

Referring to Figure 1 again, the content cone is small at the low end because at earlier stages of development the number of concepts entertained are smaller and the concepts are simple in nature. Hence, as the cone broadens so too does the complexity of content or information included. Individuals at stages of development intersecting the lower end of the cone can deal with issues and concepts of a simpler form while, on the other hand, individuals at the upper end with higher levels of maturity have the capacity for dealing with more issues and issues of greater complexity. Development, then, is both vertical and horizontal: vertical development is from lower to higher stages; horizontal development relates to the "necessary but not sufficient" requirements which must be satisfied as one moves from logical reasoning, through social role taking, to moral reasoning capabilities.

Thus, while each stage reflects a distinctly unique capability for problem solving in a science/technology/society context, we view development or progress as a continuously spiraling process. In this process, however, there are leaps and quiesence, and fixation at any stage is possible. Levels of logical reasoning, moral reasoning, and role taking maturity also seem to vary, we find, depending on the issues addressed. These apparent inconsistencies in reasoning—even when dealing with the same or similar mental and moral constructs—seem to be related to the degree of emotionality, familiarity with, interest in, and/or knowledge about the issues under consideration[7].

The goal then is to help each individual "spiral" upwards through the Socio-Scientific Reasoning cone and synchronously achieve "more adequate" problem solving capability. "More adequate" as used here refers to the idea that when applied to problem solving, the higher stages of reasoning result in solutions that are more encompassing and generalizable; they enable students to deal with greater complexity.

Application of the Socio-Scientific Reasoning Model in the Classroom

The Socio-Scientific Reasoning model therefore serves as the basis for identifying the types of learning experience and the sophistication level of those experiences important to help students develop. It recognizes that learning capabilities differ with age, grade level, interest and learning needs. Implicit in the model and in accord with stage theory is the idea that at each stage there is a characteristic form of thinking capability which determines how experiences and information are interpreted and acted upon.

The main strategy underlying all of these activities is based on Piaget's concept of equilibration. It is only when disequilibrium is created that active restructuring of thought takes place. This active restructuring leads to growth in logical reasoning, in social role taking, and in moral/ethical reasoning capabilities as well.

Restructuring of existing cognitive structures occurs when internal disequilibrium is felt by the individual. New experiences and inputs which are not readily comprehensible to the individual challenge his/her existing mode of thought by revealing inadequacies or inconsistencies in that problem solving strategy[8]. Arrestment at a given stage is partially explained by the developmental theorists as the lack of opportunities that create conflict or dissonance which place the individual in a position where he/she needs to assess his/her particular mode of thinking. Perhaps, as Clive Beck points out, the reason why people do not develop morally is because they have not had the opportunity to entertain alternatives—their imaginations have not been extended[9]. We, in addition, contend that the reason people do not advance in logical reasoning can also be attributed, to a large degree, to a similar lack of opportunities.

We have identified some of the basic elements needed to provide experiential opportunities that promote development of problem solving and decision making skills. A partial listing includes providing opportunities for students to:

- Encounter a variety of viewpoints
- Experience higher level reasoning
- Take the perspective of others
- Examine and clarify one's own ideas
- Examine the consequences and implications of one's decisions
- Defend one's position
- Evaluate possible alternatives
- Consider and recognize the role of the self to society
- Reflect on one's own value system
- Test own ideas and those of others

One educational activity which incorporates some of these elements is the classroom dilemma discussion, an activity most commonly associated with Lawrence Kohlberg and his colleagues. We have, however, modified and extended this approach to more systematically encompass critical analysis and evaluation of information and data. We have also employed such other formats as role taking, simulations, and futures forecasting and analysis methodologies.

For example, reasoning at a particular stage is not a value judgment of whether an act is good or bad, but is the pattern of the concepts entertained in judging the "ought" of rights, duties and obligations of human relationships. Younger children at lower stages reason about duties in terms of reciprocal benefits from the party—"If you do me a favor, I will do you a favor." Whereas in principled reasoning, duty is what an individual has become morally committed to do and is self-chosen. Higher stage reasoning is therefore the ability to apply value concerns (Kohlberg's major concerns include self welfare, welfare of others, sense of duty and of motives, conscience, rules, punitive justice, role taking) in a more

internalized, complex, autonomous, critical, consistent and generalized manner.

Effective discussion, however, cannot take place in a vacuum. Needed also is an information base or context from which students can begin to analyze and evaluate information. With information which they have extracted and synthesized, additional ideas and rational arguments can be developed for discussion. For curriculum activities, we have created problem situations in a variety of contexts which, according to scholars in a variety of fields, will be prominent in the next quarter century and beyond[10]. This adds another perspective to the dilemma problem—that which elicits scientific logical reasoning in addition to moral/ethical reasoning—but in a futuristic context.

These serve as mechanisms for students to put some of the ideas and judgments that have emanated from the discussion into larger structural frameworks. They also provide students with opportunities to project into the future, to think beyond their own immediate experiences, and to consider the impact of different decisions on future society.

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OVERVIEW OF *FUTURE SCENARIOS IN COMMUNICATIONS*

Purpose

From the earliest times when humans fashioned the first tools, such as implements for hunting, technology has been a dominant change agent in the course of history. In today's world new technological developments appear more rapidly and with greater frequency. Yet, we seldom step aside to reflect upon how these technologies will impact upon our lives, changing what we do and how we go about accomplishing our activities. To better prepare our students for the future, it is important to include opportunites for them to critically examine the developments and potential applications of new technologies.

The important goal of this module is to help students begin to think about change and factors that influence change. They will live in a world where change will take place at accelerated rates. They will encounter new choices and alternatives. Experience in learning to think about change in a larger context will better prepare students for future decision making.

This module employs futures forecasting techniques as one strategy to study change. The types of forecasts people make and how the forecasts are interpreted enter into the decision making process. The development of the telephone system in the U.S., Section I of this module, exemplifies this notion. In this first section, change is examined from an historical perspective. In Section II, students will examine the many ways that computers can be used and new types of changes. This section requires students to take a future oriented perspective. They will consider possibilities and the desirability of what is possible.

Future Scenarios in Communications in the School Curriculum

This module, designed for secondary school students, grades 7 and 8, is appropriate for a number of subject areas: social studies, language arts, science, etc. The particular course in which this module is taught will, of course, influence the manner in which the concepts and issues are examined.

In science classes the teacher might emphasize the scientific principles and technological aspects of the telephone and the computer. In social science classes, the teacher might emphasize the social, political, or economic effects of new technologies.

The main intent is to engage students to think about the future and recognize that effective future planning and decision making are dependent upon knowledge from many disciplines. Moreover, the specific techniques of futures forecasting have wide applications and encompass skills developed in the various subject areas.

The module may be incorporated into the curriculum in a number of ways. The module may be used as a single unit of study, or portions may be interspersed in the curriculum at appropriate or convenient times. However, the activities and readings should be presented in the sequential order since the activities frequently depend upon information derived from a preceding activity.

Movies and filmstrips which provide additional background information about the development and science of the telephone and computer are highly recommended. They will enhance the module activities as well as heighten student interest. Many are available, free of charge, from Bell Laboratories, the telephone company or computer corporations.

Objectives of the Module

Student accomplishments to be achieved with the use of the readings and activities are specified by the following student objectives. After completing the module students will be able to:

- Trace some historical developments of the telephone from 1876 to 1910.
- Trace some historical developments of the electronic computer from 1890 to the present time.
- Identify selected social impacts of the telephone and the electronic computer.
- Describe the forecasting techniques of the Delphi probe, the Cross-Impact Matrix, Trend Analysis and Scenario development.
- Conduct a Delphi probe in their classroom to identify the range of preferences regarding a particular question.
- Carry out an analysis of the interaction among socio-economic factors in communication systems using the Cross Impact Matrix method.
- Conduct a trend analysis for selected measures of telephone and computer development and use.
- Develop scenarios which examine alternative futures.

Components of Future Scenarios in Communications

- Student's Guide
- Teacher's Guide
- Student Handouts — 9
- Transparencies for overhead projection — 5

Future Scenarios in Communications is comprised of two major sections. Section I examines the development of the telephone system in the United States and

introduces four futures forecasting techniques. Section II examines the development and applications of the computer. Students will use the forecasting techniques learned in the preceding section to make their predictions about future trends and developments.

Suggested Teaching Schedule

Class Period	Activities
PART I: THE TELEPHONE	
1	Introductory exercise and discussion. Assigment of Activity 1
2	Completion of Activity 1 — Pre-Telephone Chart and class discussion
3	Reading 1 and assignment of Activity 2
4	Student presentations of Activity 2 — Selling the Telephone
5	Reading 2 and class discussion
6	Activity 3 — Scenario Writing (this may be assigned for homework)
7	Students present their scenarios
8	Reading 3 and discussion
9	Activity 4 — First Round of Delphi Survey
10	Activity 4 — Second Round of Delphi Survey. Presentation of results. Completion of Cross Impact Matrix Analysis Chart
11	Activity 5 — Scenario writing
12	Activity 6 — Trend extrapolation and discussion of results. (This activity may be accomplished as a homework assignment and the additional time may be devoted to the discussion of applying graphing techniques to future forecasting.)
13	Activity 7 — A Role Playing Exercise
PART II: THE COMPUTER	
14	Reading 4 and class discussion
15	Activity 8 — Scenario writing
16	Reading 5 and class discussion
17	Activity 9 — Delphi Survey, Round One
18	Activity 9 — Delphi Survey, Round Two and discussion
19	Reading 6 and class discussion
20	Activity 10 — The Futures Wheel
21	Reading 7 and class discussion
22	Activity 11 — Forecasting Computer Trends
23	Activity 12 — Scenario Writing
24	Presentation of Scenarios

FUTURES FORECASTING METHODOLOGIES

Forecasting and Planning

Forecasting and planning are common, everyday activities carried out by all people. Although many people would deny that there are unique methodologies involved in these activities, few would question their value.

For the individual, forecasting and planning — at the lowest level of complexity — are almost automatic. If someone inspects the sky on a cloudy day and subsequently takes a raincoat to work, one has engaged in both activities. We look ahead for many reasons — because we are inquisitive, because we may want to change our current situation — but more importantly, because we believe it is useful to do so. If individuals or organizations forecast correctly, or reasonably so, and then plan and act accordingly, things tend to work out much more satisfactorily. Not surprisingly, forecasting sometimes has its highest payoff when events do not turn out as forecasted; a forecast of disaster may lead people to change their actions and thus avoid the disaster, or at least moderate its consequences. Without forecasting, without anticipation, actions taken today may lead to consequences that materialize so quickly that it would be impossible for humans to protect themselves or under beneficial conditions to profit from such consequences.

Forecasting and planning are aspects of decision-making. A decision is not made without some idea of what to expect; if that idea is made explicit we clearly have a forecast. Plans are developed on the basis of the forecast to increase the chance of arriving at a chosen goal. For decision-making, the value of a forecast does not necessarily lie in whether or not it comes true, but in its utility in helping decision-makers to choose more desirable courses of action and to act effectively. Predictions state *what will happen*. Whereas, forecasting makes predictive statements about *what will happen if . . .* Forecasting thus allows us to examine what can happen, what can be changed, and how we might bring about change. For educators, forecasting and futures studies provide a vehicle for helping students to contemplate the nature of the world in which they will be living and working. With some perspective of present day trends and future projections of population, technological developments, economics, social systems and various other parameters, students will be in a better position to plan for a vocation, a satisfying lifestyle, etc. and to cope with unanticipated changes in our society.

Forecasting Methodology

Forecasting, as used in connection with this module, employs a set of formal methods to systematically and logically examine data and information. In this manner, one can begin to chart a direction of change and consider alternative future possibilities. A forecast thus yields a measure of the future that is based on certain assumptions, information and the interaction of the relevant factors. Using the given methodologies, different forecasters can expect to obtain a fairly consistent and reliable image of the future. That image can, therefore, provide a foundation for planning, decision making and acting.

Future forecasts may be made using a number of complementary techniques. There are three basic approaches to forecasting: exploratory forecasting, normative forecasting and modeling or simulation.

Exploratory forecasting begins with a given data base and projects into the future. As such, it makes use of extrapolative techniques to analyze data for trends. By contrast, normative forecasting looks backward toward the present. It begins with a set of desired goals and objectives for some future time, and derives the actions necessary to proceed from the present state of affairs to a preferred future. Modeling/simulation, on the other hand, attempts to analyze the impact and interactions of known variables or models to arrive at a forecast of alternative futures. This last approach often uses a computer and complex mathematics to simulate and test possible futures, and will, therefore, not be used in this module. Instead, the activities in the student guide are a mix of exploratory and normative techniques.

Each forecasting approach has its unique purpose as well as limitations. In order to obtain a more comprehensive view or insight into the future, most forecasters use a number of techniques in combination.

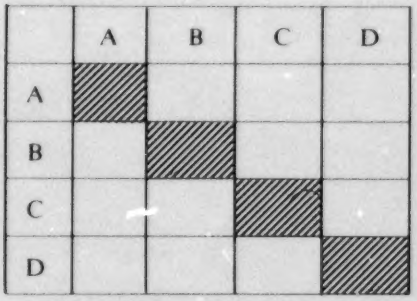
The Delphi Technique

This widely used futures research technique was developed as a mechanism for eliciting and refining the opinions of a group of experts. It makes use of a series of two or three questionnaires which are usually mailed to the participating experts whose identities are withheld from one another. A compilation of the responses from the first Delphi questionnaire is developed into a second questionnaire which is presented to the same panel of experts. Each individual is asked to reconsider his/her responses in light of the collective opinions from the first Delphi round. If a third questionnaire is employed, the participants are provided with a summary of round two responses and the reasons why panel members changed their initial responses. The participants then have an opportunity to adjust their responses one last time. The participants thus make judgments based on their own ideas and opinions of other experts.

Cross Impact Matrix

The Cross Impact Matrix is used in this module as a follow-up to the Delphi survey. The survey leads to the identification of a series of discrete items or occur-

rences about which the "experts" have reached a consensus. The Delphi technique does not explore interactions among the items which have been identified. The Cross Impact Matrix allows us to explore these interactions to determine the effect (positive or negative) and the force of the interaction. This analysis is accomplished with the use of a grid consisting of rows and columns. The rows and columns are labeled with the items or occurrences from the Delphi survey as shown.



The investigator asks, what is the impact of item A on item B, and how strong is the effect? By way of example, the matrix above shows a positive effect (arrow pointing up) and a strong effect (relatively large arrow). By carrying out this analysis systematically, one can begin to evaluate the relationship between different elements and determine the desirabilities of various effects. This type of analysis offers a convenient method to gain an overview of the interrelationships and help identify the trade-offs involved when one seeks certain goals.

Trend Extrapolation

This mathematical technique, using trend curves to forecast future conditions, is a powerful one but like all forecasting procedures make certain assumptions. The assumption underlying this technique is that the past and present trend curves (a plot of a measure of performance versus time) will continue in the future as they have in the past. Extension, or extrapolation, of the curve should, therefore, yield the performance level at any given point in the future. New technological innovations, however, are difficult, if not impossible, to predict. A pair of trend extrapolations is therefore often produced which correspond to optimistic and pessimistic projections of future performance, availability, etc.

This technique can, obviously, be handled in a very rigorous fashion. In the module its use will be restricted to concepts and processes appropriate for students in grades 7 to 9.

Scenario Forecasting

A scenario is a narrative which gives substance to and integrates forecasts of the future. It usually involves the development and description of a sequence of events leading from a given point in time to a forecasted future state. The narrative presentation provides the freedom and flexibility necessary to discuss the complex interaction of factors and variables of the preferable future and to weave a detailed description of alternatives perceived by the writer. It explores possibilities in an imaginative and creative manner.

The scenario thus allows one to examine changes and interaction of factors in a broader perspective. This process of relating events and considering consequences can serve two useful purposes for the decision maker. It can serve as a planning guide. One determines a certain set of goals for the future and uses the scenario to lay out the steps necessary to achieve those goals. It can also be used to examine effects of particular decisions since different decisions lead to different futures. The scenario, in this instance, would describe the implications of a decision. This would allow one to weigh advantages and disadvantages and decide if the result is desirable.

Scenarios can be presented in a number of ways, ranging from science fiction story dramatization, to planning diagrams to visionary drawings. Its underlying purpose, however, is the exploration of a possible alternative or unique and unusual idea, coordinating the available information.

Although scenario writing is a frequent technique employed in futures forecasting, it is also a useful tool for examining the ways the components of a situation or activity interact and effect change. As the students develop their scenarios, it is hoped that they will gain an awareness of the characteristics and boundaries of different variables.

Getting Started

Thinking futuristically such as in scenario writing is often difficult because our thinking is so influenced by what we know and what we have experienced. The following are some simple ways to help get students started in projecting into the future, by generating unusual ideas or ideas not yet considered.

Brainstorming — This is a useful technique for writing a scenario as a group activity. The purpose of this technique is to try to obtain as many ideas as possible. Present to the group the basic theme that has been selected. Let each person in turn contribute an idea and continue going around the group until all possible ideas seem to be exhausted. One person's idea often leads to other ideas. Or, ideas may result from combining several ideas. *The important rule for brainstorming is to reserve judgment.* No one critically comments on another person's idea. Each and every idea is treated equally, no matter how far-fetched it may seem. Have one person record the ideas, and at the end of the session the list will be read. Then the group can decide which ideas are more interesting, practical or feasible to incorporate in the scenario.

Attribute Listing — The attribute listing technique involves listing every attribute or characteristic of an object or event, so that one can begin to think about the object or event in new and different ways. Take, for example, a situation in which one has to sell a warehouse of old pencils. Perhaps one would have a better chance of selling the pencils if other uses could be found for them.

First, list all of the attributes and components of the pencil, such as:

wood	long
lead	slender
color paint	inflexible
rubber eraser	strong
metal ring (joining eraser)	light

For each of the attributes some of its possible uses can be described. Wood, for instance, can be used for building, firewood, shaved down for packing materials, splinting, etc. For the erasers, which are soft and bouncy, other possible uses might result from gluing them together and thus forming a pin cushion or a doormat, or perhaps they may be used as corks for small bottles.

By thinking of unconventional or unusual uses, one might discover a new market for old pencils, and one could therefore quickly sell the contents of the warehouse.

Thinking Visually

Ideas can be communicated in ways other than by words. Sometimes it is helpful for students to put ideas down in the form of drawings and diagrams. By recording one's thought in a diagram plan, one has made a record that can be then examined, added to, related to others and then changed. A great deal of information can be communicated in this way even though the drawing or sketch is quite simple and rudimentary.

Guide To Section I:

The Telephone

Overview

The intent of this section is to introduce students to a few of the basic techniques employed in futures forecasting and guide them through investigation of a very familiar subject — the telephone. Students will be transported back in time so that they can create for themselves an understanding of the concept of change and the impact of that change. Change is a natural occurrence but difficult to visualize or isolate as it is occurring within a short time frame (especially for young students whose experiences and memories do not extend beyond a decade). Moreover, the direction, scope and type of change results from a variety of decisions made and the particular actions taken. It is important for the student to understand that other possible alternatives might have taken place. The telephone, as we know it today in the United States, did not just happen but evolved from particular decisions and preferences. (This is most evident if one has had experience with telephones in other countries.)

The impact and significance of change can perhaps be more readily understood by young students when they study the course of past events. Inventions and technical applications have numerous ramifications and when examined with consideration of possible alternatives may help students understand the interaction of complex processes. Hence, the impact of the telephone and its role as a change agent are examined to set the stage for the second part of this module when students are asked to project into the unknown future and take into account possible social, political and economic effects. It is our belief that understanding past effects and interactions, students can gain greater awareness of future potentials.

Introduction. Completion of the Telephone Dial

Description

On page 1 of the Student's Guide of *Future Scenarios in Communications*, a blank telephone dial and touch tone buttons are shown. The numerals and letters are to be written in their appropriate places.

Student Objectives

- To discover that familiar details are not often stored in memory.
- To develop interest in the activities to be subsequently presented.

Comments and Suggestions

This simple exercise is self-explanatory and requires no additional instructions other than to remind the students to work on their own since they will not be graded on their results. Have students copy the diagram on a separate sheet and fill in the appropriate letters and numbers. The purpose is to highlight the difficulty in recalling details of an instrument we use routinely. The class will discover that very few people can accurately reproduce the numerals and letters on the telephone dial. This exercise can serve as a useful lead-in to a discussion of technology in our lives, how we perceive technology and its aspects we take for granted.

Some questions for class discussion might include:

- What other things do we use that we don't think about? Why?
- How do we feel when an appliance or machine doesn't work? Why?
- What do we do when a machine breaks down? Repair? Replace?
- If we did not have telephones, how might our lives be different?

Activity 1: Living Without a Telephone

- **Student Handout 1:** Pre-telephone Communications Chart — Urban Comunity
- **Student Handout 2:** Pre-telephone Communications Chart — Rural Community

Description

Students will consider how people conducted their daily affairs in pre-telephone days by providing a solution for the accomplishment of a particular task. Eleven persons and their tasks are listed on the two charts in the student's guide and reproduced as handouts.

Student Objectives

- To gain an awareness of how the telephone has changed our work and leisure activities.
- To examine the alternative modes of communication in pre-telephone days.
- To consider lifestyles in urban and rural communities prior to the telephone.

Student Activities

- Class discussion on telephone usage.
- Individually or in small groups students will complete a section of the Pre-telephone Charts.

Procedures and Suggestions

- **Class Discussion.** Prior to the assignment, briefly consider in a class discussion:
  - — The different activities the students accomplish through the use of the telephone. List these on the board.
  - — The different activities accomplished by their parents through the use of the telephone. Again list these on the board.
  - — Compare the two lists and determine the various categories of communications that involve telephone conversations (or recorded messages) —

entertainment	business
news, weather	social
emergency aid	information, i.e.,
shopping	library service, etc.

- **Completion of Pre-telephone Communication Charts:** Completion of the charts can be accomplished in several ways.
  - — *Individually:* Assign each student to complete portions of the *urban* chart or *rural* chart. When completed, the responses of the entire class can be compared.
  - — *Small Groups:* Divide the class into groups of 3 or 4 with each group responsible for one of the charts. The responses of the groups can then be compared and summarized during class discussion.

    Students working in small groups may be the preferred method for completing this activity. Differing opinions can very well lead to greater diversity of ideas as well as make it easier to complete the charts.

    Under the title of each person listed are two communications tasks. Students are to suggest under "1" how that task might be accomplished and under "2," estimate the length of time required to accomplish it. If the students work in groups, they may wish to share their many ideas in the class presentation. In this case, they can expand the chart using larger sheets of paper or make a separate chart for each person so that they have more space for additional suggestions.

    In some instances it may be difficult for students to imagine life in the late 1800's. If available, display some pictures depicting lifestyles of that period.

    Detailed characterizations of the persons listed on the charts have not been specifically spelled out to permit a degree of flexibility. Use your judgment and discretion in providing additional constraints and information regarding each of the individuals such as the size of the town, the place of residence, availability of transportation, etc.

- **Class Discussion and Summary.** After students have completed their assignment, arrange a short discussion session for students to share their results. Examine the different communication needs of the two types of communities. What are the commonalities? Differences? The major objective of this activity is to create for students an awareness of the limited range of communications, its slowness and intermediary messengers required, prior to the widespread use of the telephone. Therefore, focus the discussion on the lifestyle of the earlier times and the degree of interpersonal contact and information exchange among people living in various communities.

URBAN COMMUNITY

Owner of a Vegetable Warehouse Learn that potato shipment has been delayed by storm	**Research Scientist** Discuss a possible new discovery with scientists 100 miles away	**Fire Chief of City** Call for more equipment to a fire spreading throughout the block	**Housewife** Contact repair man to fix the leaking roof	**Worker in a Factory** Report that he/she will not be in to work
1.				
2.				
Find another source of potatoes until shipment arrives	Inform mayor that the city water supply contains dangerous germs.	Call meeting of all company captains	Tell children at home that she will be late in returning home	Invite friends to a party
1.				
2.				
3.				
4.				

DO NOT WRITE IN YOUR BOOK

RURAL COMMUNITY

Farmer (wheat farm in midwest. Nearest neighbor 3 miles)	**Newspaper Editor** local paper that publishes weekly; circulation 2,000; has staff of 3 others	**Butcher and Owner of meat market** (Sell & delivers to local customers	**Sheriff** (4-man force in rural town)	**Eighth-grade student** (Walks to school 2 miles away; 5-room school)	**Recent Immigrant** (apprentice in a tailor shop. Works from 7 AM to 7 PM. Lives in upstairs loft of shop. Cannot read or write English)
Order supplies for spring planting	Receive news of the presidential election	Get doctor for worker who has had an accident in shop	Inform the nearby towns of an escaped prisoner	Gets sick at school and wants to tell mother.	Contact relative in city 100 miles away
1.					
2.					
Sell the wheat harvest	Sending back story from the state capitol	Stop an order placed last month to stockyard because of an over-supply of meat	Round up a search team for a lost child	Arrange for trip to state capitol (needs hotel room, train ticket, tour guide)	Arrange for brother in native country to come over to work in shop
3.					
4.					
5.					
6.					

DO NOT WRITE IN YOUR BOOK

Reading 1: Early Uses of the Telephone

Summary

How people first reacted to the telephone and its initial uses are described.

Student Objectives

- To acquire some historical information on the telephone and its uses.
- To gain an awareness that initial perceptions about an invention frequently differ from later views.
- To discover some of the obstacles that new inventions often encounter.

Comments and Suggestions

After students have completed the reading, you may wish to have them consider the following questions in class discussion or a written exercise.

- Why might people be skeptical about the use of the telephone in daily activities?
- Why weren't some of the early suggestions for telephone uses adopted?
- Why did the use of the telephone occur earlier in industries such as mining?
- Why did many people view the telephone as a luxury or a toy?

Activity 2: Selling the Telephone

Description

This simulation activity offers students the opportunity to experience some of the early reactions and responses to the telephone. Some of the points made in the preceding reading are highlighted in this exercise as students take the "pro" or "con" position regarding the telephone.

Student Objectives

- To gain an understanding of the different ways that people first perceived the telephone.
- To develop arguments in support of a given role position.
- To learn to take the perspective of another person.

Student Activities

- Students will present a series of dialogues between a telephone salesperson and potential customer. They may select one of the roles listed in the student's guide or a role of their own choosing. Each role character is paired with a telephone salesperson. The salesperson must try to convince the other person that he/she needs a telephone. The other person presents counter arguments and reasons for not wanting a telephone.
- After all the presentations have been made, the class as a whole may informally identify the best "sales pitch" and best arguments for not wanting a telephone.

Comments and Suggestions

Since the telephone has become such an integral part of our daily lives, it is difficult for us to imagine why people were so resistent to subscribing to telephone service. To help the students gain a perspective of negative reactions to the telephone, point out some of the difficulties associated with early telephone service. Some are identified in the subsequent readings and include: the inconvenience of using the first telephones; the poor quality of sound transmission; the paucity of people who have telephones; the limited distance of telephone lines; the frequent breakdown of equipment; the long waits in getting a call connected; the high cost of telephone subscriptions, etc. In addition to technical problems, certain psychological and social aspects also contributed to the public's skepticism. For many people, personal and business habits had to be altered or adjusted in order to optimally use the telephone. In many instances, the early telephone presented more obstacles than convenience.

Reading 2: The Telephone — A Communications Network

Summary

The concept of telephone communications as a systems network of many interdependent components and services is presented. Early developments of this system are examined through examples of problems and needs that arose.

Student Objectives

- To gain an understanding of telephone communications as an organized system comprised of many interdependent parts.
- To gain an understanding of the development of the communications industry in the United States.

Comments and Suggestions

A class discussion should help to define some of the following words and concepts which students encountered in the reading.

corporations, subsidiaries, local companies
public service industries
investment, capital and profits
profit needs vs. public needs
patents, licensing

Activity 3: Scenes of the "Future": An Exercise in Scenario Writing

Description

The ways in which futurists often employ scenarios are described to the students. A list of scenario themes are presented. Students will select one of the themes for their scenario or else develop one of their own. Some guidelines for scenario writing are included.

Student Objectives

- To employ scenario writing as a futures forecasting technique — planning towards a goal or examining the implications of that goal.
- To consider some possible alternatives for the use of the telephone from the perspective of a person living at the turn of the century.

Student Activities

Students will write a two to three page scenario based on one of the themes suggested or the students' own ideas. This written exercise may be accomplished individually or in groups.

Comments and Suggestions

- Encourage students to use their imagination and try to project the thinking of a person living 70 years ago. They should not be constrained by their knowledge of the telephone system as it exists today.
- Review the section on scenario writing covered earlier in this guide. You may wish to try some of the techniques for generating unusual ideas found under the section titled "Getting Started." Students may find these strategies helpful, particularly if the scenario writing is a group effort.
- Examine with the students the suggested approaches to scenario writing given in the Student's Guide.
- Have the students, individually or in small groups, select the scenario theme of their choice. Or alternately, students may have other scenario ideas they wish to develop; the themes listed are but a few possibilities. The scenario can be written in a narrative (short story, diary, newspaper article, letter, etc.) or dramatic (skit, monologue, play, etc.) form.
- Students should utilize the information presented in the preceding reading as a point of departure and try to envision how people originally responded to the discovery of voice transmission by wire.
- The primary objective of this activity is to provide students with an opportunity to plan towards a given goal or examine the ramifications of a given goal decision. In either case, the student, as he/she proceeds to develop his/her detailed plans/steps, begins to examine the interaction of multiple factors and considers how different factors respond to or affect an outcome. Additionally, the exploration of a "far out" or "far fetched" idea brings out new possibilities, and students can perhaps begin to gain an understanding that applications of technology are linked to the perceptions and needs of the particular community and its customs and the decisions to apply it in a certain way. Future scenarios, therefore, are not entirely speculations of fantasy, but a planning procedure or examination of alternatives which appear to depart from reality when the time frame is extended to a far distant future time.
- When students have completed their scenario, have them share it with the class by reading it aloud or presenting it as a dramatization.

Reading 3: Changes in Telephone Technology and Growth

Summary

Some technical developments are described to point out the necessary refinements required in order for telephone communications to be practical over longer distance as well as to become more convenient for the user. Moreover, certain problems could not be resolved until new technologies were discovered.

Student Objectives

- To gain an understanding that the application of certain inventions necessitates continuous refinement as well as additional new technologies.
- To gain an understanding of some of the many changes that occurred in telephone technology.

Comments and Suggestions

- The diagrams describing the types of switching networks may require further clarification. The need for exchanges and switching can perhaps be better understood by the students if they realize that each telephone requires a separate wire and when a call is made to another party the respective telephone wires must be physically connected.
- A simple exercise to illustrate this concept can be performed in class. Take several feet of sturdy string and have a few students take places along the string to signify a single line system. Have them then devise ways to call one another along the line. This is an example of a single party line which does not involve the intervention of an operator. How will they notify someone to pick up the telephone?

Demonstrate the concept of station switching by using separate pieces of string all leading to a central person who switches the calls between the different callers. Duplicate this set-up with another group of

students. Ask them to figure a method by which the two groups can communicate with one another. The idea of central switching and the use of trunk lines should thus become obvious.

- The differences between telephones in the early days and today can be made more explicit for the students by having them identify and list characteristics of the early telephone and compare them with the telephone as they know it now. Have them also consider the similarities.

Activity 4: Developing Your Telephone System and the Delphi and the Cross Impact Matrix Analysis Techniques in Planning Strategies

- **Student Handout 3:** Delphi Questionnaire: A Telephone Exchange for Middletown
- **Transparency 1:** Cross Impact Matrix Chart

Description

Students are placed in a hypothetical situation in which they are to determine how to best develop a telephone system in their rural community at the turn of the century. They will base their decisions on the information acquired from their Delphi Survey and Cross Impact Matrix Analysis.

Students will participate in two rounds of a Delphi survey. The survey consists of stating their choice of preferred outcomes on eleven statements. The results will then be examined using the Cross Impact Matrix analysis. In this analysis the students will consider the occurrence of one statement (variable) and determine how that will effect the occurrence of the other statement (variable).

Student Objectives

- To identify their preferences regarding the establishment of a telephone company using a Delphi survey.
- To analyze the interaction of selected variables using the Cross Impact Matrix.

Student Activities

- Students individually will respond to two rounds of the Delphi questionnaire.
- The class as a group will discuss the effects of choices made and complete the Cross Impact Matrix chart.

Procedures and Suggestions

Delphi Survey

Round 1. Each student will need two copies of the Delphi Questionnaire, but distribute only one copy to the students at this time (save the remainder for Round 2). Have the students follow the instructions in the Student's Guide to make their selection of preferred outcomes for each of the eleven statements. Students will indicate their eleven choices in the appropriate places on the response sheet and submit it to the Delphi panel moderator. (Teacher or Class Member)

In making their selections the students will first determine the priority of each item choice. Each item will then be ranked. One or more items can be viewed as extremely important, but ranking these priorities forces a choice. This process demonstrates a systematic strategy for decision-making. After indicating their choice, students shall write a short statement on the response sheet, explaining the important considerations that influenced the particular choice. (i.e. Give a reason for selecting that choice.)

The Delphi Panel Moderator will collect the responses and summarize the results. Post these results for the class to examine.

Round 2. Conduct a second round of the Delphi probe after the class has had an opportunity to examine the results. Again, distribute a second copy of the response form, have the student indicate their choices and provide a reason for each choice. Remind the students to work independently — anonymity is an important feature of this survey. Discussion of Round 1 results is unnecessary.

Collect responses and again summarize. The item choices will be examined in greater depth in the Cross Impact Matrix (CIM) analysis. The item choice receiving the greatest number of votes will serve to complete the statement. At this time you may wish to discuss the summarized results and the reasons why certain items were favored over others. The class will select two additional statements for examination by the CIM method. (In addition to items 1, 2, 6, 11).

Cross Impact Matrix Analysis

This exercise is conducted as a class discussion where the entire class will determine the extent of the impact. The procedure is explained in detail in the Student's Guide.

You may wish to begin by reviewing with the students the examples given on pages 25 and 26 of the Student's Guide. Then have the class select two additional statements for the analysis.

Complete the analysis using the chart reproduced as an overhead transparency or the chart copied on the blackboard. The preferred statements are entered in the column and row headings using the abbreviations suggested on page 24 of the Student's Guide. The completed statements should be also displayed on the board so that the students can refer to them as needed.

The analysis is a systematic technique for examining the effect of one factor on another factor. In this module, students will evaluate the compatibility of one preference with another preference. That is, will the preferred choice lead to the occurrence of the other preferred choice? Students are to determine the effect by indicating *yes* or *no* and explain how they arrived at the decision.

Yes is indicated by a [1]
No is indicated by a [0]

The symbol is then entered in the appropriate box.

Determine also if other class members agree or disagree with the analysis. It is important to emphasize that different interpretations are possible but encourage students to provide a strong argument that will uphold their position. Discuss one pair of impact statements at a time and have the class vote on the decision.

Upon completion of the Cross Impact Matrix Chart, total the score and examine the findings. Determine if the class is satisfied with the findings (i.e., are there many items that do not work well together?). In the event that many interactions are negative it may mean that the choices made were not compatible. Have the class make alternative selections by selecting other statement completion items from the Delphi Survey and analyze the impacts. Do this until the results are viewed as satisfactory. The class, however, should be reminded that a perfect situation which meets all the criteria optimally is a near impossibility. In most real life situations, "trade-offs" are necessary. The critical decision is deciding whether or not the system can function effectively in light of the compromises and whether items of greater importance have been adequately taken into account. (The class may also discover that items previously receiving higher priority are now less significant when compared with other goals.)

Delphi Questionnaire: A Telephone Exchange for Middletown

Below are eleven statements (#1-11) to be completed by one of several possible endings. Your preferred choice should be made in the following way:

Step 1: **Priority Rating.** Read each statement and the possible phrases for completing that statement. Indicate how important you feel each of the choices to be by placing the appropriate number of stars next to the letter **on the response form** that corresponds to the letter of the phrase.

**** — extremely important
*** — important
** — slight importance
* — no importance

Step 2: **Ranking.** Arrange the statement endings from most important to least important. For example, if you feel that "d" is most important it should be ranked #1. Write that letter in the appropriate space next to rank #1. Do the same for rank #2, and so on, until all the possible choices have been ranked.

How Important

1. **Purpose of the telephone exchange in the town:**

____ a) to make a handsome profit quickly so that local investors (shareholders) will be pleased they invested their money in this new venture.
____ b) to make it easier and faster for the business man to conduct business.
____ c) to summon help in emergencies (i.e., police, firemen, doctor, etc.)
____ d) to make it possible for the townspeople to visit with one another without having to travel.
____ e) to obtain news and information (e.g., election return, time, weather reports).

Rank #1____ #2____ #3____ #4____ #5____

2. **Telephone service should first be made available to:**

____ a) the people who can afford to subscribe to the service.
____ b) the people who have greatest need for a telephone (e.g., invalids, doctors, drugstores, town officials, etc.).
____ c) everyone in town and paid for by local taxes.

Rank #1____ #2____ #3____

3. **The company will obtain the equipment by:**

____ a) renting from the Bell system because the equipment is standardized and lines can be readily connected with other communities using Bell equipment. Furthermore, the rental fee will include the cost of service and repairs.
____ b) buying from independent equipment manufacturers. People will own their telephones.
____ c) forming its own manufacturing company to produce equipment for its own needs.

Rank #1____ #2____ #3____

4. **The fairest way to charge for the telephone service will be to:**

____ a) charge a single yearly fee such as $150 for businesses and $100 for residences.
____ b) charge the user for the number of calls made no matter how long the user is on the line.
____ c) charge for the length of time the caller is on the line.
____ d) charge according to the distance between the caller and receiver. For instance, calling one's neighbor will be less than calling from the center of town to a person in the outskirts of town.
____ e) split the cost of the call between the caller and receiver.

Rank #1____ #2____ #3____ #4____ #5____

5. **Repairs to telephone instruments should be:**

____ a) paid by the user as needed. In this way people will be more careful in handling the telephone and would not be paying for service they do not use.
____ b) provided by the company which will set

aside part of the subscription fee for possible repair service.

____ c) a service provided by the town and paid by taxes.

Rank #1____ #2____ #3____

6. **If the telephone lines, poles, etc. are damaged by snow and ice storms, for instance, the cost for repairs should be:**

____ a) assumed by the company which has included a repair service fee as part of the total subscription charge.

____ b) paid by those who are connected to that particular line.

____ c) shared among all the subscribers who will then be billed by the company for that particular repair service. In this method one pays for the service that is actually used.)

Rank #1____ #2____ #3____

7. **The telephone operators should be:**

____ a) the telegraph and office messenger boys who have lost their jobs as messages will no longer need to be hand delivered.

____ b) persons who have had previous training as telegraph operators.

____ c) young women, because in other telephone exchanges they have been shown to be more courteous and efficient.

Rank #1____ #2____ #3____

8. **If it is difficult to raise enough money in the beginning to build an exchange to serve everyone in the community and to run telephone lines to every store, office and house, the company should limit the service by:**

____ a) establishing lines only in the business district.

____ b) offering only party-lines which would reduce cost.

____ c) establishing lines to connect with the neighboring towns and place the telephones in public places.

____ d) establishing lines in the part of town where there is the greatest number of people willing to subscribe to the telephone service.

Rank #1____ #2____ #3____ #4____

9. **The telephone exchange should list the subscribers:**

____ a) name only as this is a more personal type of service. In a small town the operators will know everyone by name anyway. It will be easier when people don't have to look up a number each time they make a call.

____ b) assigned telephone number so that the operators will not have to memorize all the names in the exchange to make the connection.

____ c) house number and street name so numbers don't change when people move.

Rank #1____ #2____ #3____

10. **The telephone company can best serve its subscribers by:**

____ a) offering low taxes.

____ b) establishing long-distance lines to connect with other towns.

____ c) connecting calls quickly and does not keep the caller waiting.

____ d) adopting new telephone improvements quickly so that the calls can be made easily, the conversation will not be interrupted by other noises, the calls come through loudly and clearly, etc.

Rank #1____ #2____ #3____ #4____

11. **The telephone company should be:**

____ a) run as a private independent company with the company officers making decisions for its investors.

____ b) run as a community service department of the local town government to serve the needs of the community.

____ c) run by the subscribers such as a mutual company or a cooperative where each subscriber helps to decide the type of service and equipment one wants and how to best provide it.

____ d) run as part of the Bell System which can provide engineering expertise and long distance connections to other parts of the country.

Rank #1____ #2____ #3____ #4____

CROSS-IMPACT MATRIX CHART: Example

IF THIS DECISION WERE MADE, **THEN THIS OUTCOME WILL OCCUR:**

Statement: _____ **Choice:** _____	_____ _____	_____ _____	_____ _____	_____ _____	_____ _____	_____ _____	**TOTAL**
Statement: _____ Choice: _____							
_____ _____							
_____ _____							
_____ _____							
_____ _____							
_____ _____							

CROSS-IMPACT MATRIX CHART: Example

IF THIS DECISION WERE MADE, **THEN THIS OUTCOME WILL OCCUR:**

Statement: Choice:	1) purpose a. profit	2) availability b. need	3) equipment b. ownership	6) disaster repair b. by user	10) service a. low rates	11) organization c. mutual	TOTAL
Statement: Choice: 1) purpose a) profit		0	0	1	0	0	1
2) availability b) need	0		1	0	1	1	3
3) equipment b) ownership	0	0		1	0	1	2
6) disaster repair b) by user	1	0	1		1	1	4
10) service a) low rates	0	1	1	1		1	4
11) organization c) mutual	0	1	1	0	1		3

Activity 5: Scenario — A Plan for Your Telephone Company

Description

In this scenario writing exercise students will use as an information base the data acquired from Activity 4. The scenario will thus describe their concept of a telephone system in "Middletown," a hypothetical rural community at the turn of the century.

Student Objectives

- To project plans based on previously selected options.
- To consider future implications of particular decisions by predicting impossible outcomes.

Student Activity

Students will write a two to three page scenario to be completed individually or in small groups.

Procedures and Suggestions

- The choices made by the students in the Delphi Survey and Cross Impact Matrix Analysis will serve as the information base for this scenario writing exercise. The scenario should contain the detailed procedures for the development of a telephone exchange in "Middletown." In a sense, the scenario is a compilation of the choices selected and put in a narrative form. Additionally, it examines the implications and consequences of those choices.
- The following considerations should therefore be incorporated in the students' scenario.
  - — How will the funds for building the exchange be obtained?
  - — Who will be served by the system?
  - — How will the customers be charged?
  - — How will the company be organized?
  - — What features of the telephone system will be most attractive to the townspeople?
- Students may work on this assignment individually or in small groups. Listed in the Student's Guide are some suggested scenario formats. Again, encourage students to be imaginative. They may wish to use pictures, graphs and other display techniques to illustrate their ideas.

Activity 6: Trend Extrapolation — Forecasting the Rate of Growth

- **Student Handout 4:** Graph 1
- **Student Handout 5:** Graph 2
- **Student Handout 6:** Graph 3
- **Student Handout 7:** Graph 4
- **Transparency 2:** Graph 1
- **Transparency 3:** Graph 2
- **Transparency 4:** Graph 3
- **Transparency 5:** Graph 4

Description

Four graphs describing telephone growth will be completed by students to forecast future trends.

- Graph 1: Growth in the Number of Telephones, 1876-1898
- Graph 2: Growth in the Number of Telephones, 1876-1908
- Graph 3: Growth in the Miles of Wire, 1880-1900
- Graph 4: Growth in the Number of Telephones for Each 1,000 Persons, 1896-1910

Student Objectives

To gain experience in using trend extrapolation for forecasting the future.

Student Activities

Students will complete the four graphs to make predictions about a future year by extrapolating the given growth curves. They should discuss the results of each graph before they proceed to the next graph. (Do not distribute the next graph until the preceding has been completed.)

Procedures and Suggestions

- If students have had little experience with graphing techniques, review with them some of the basic concepts. The examples given in the Student's Guide may serve as a useful introduction.
- Assign students to complete Graph 1. Have them "fit the curve" to the data points for the years 1876 to 1898 and then extend the trend line using a broken (- - -) or dotted line (. . .).

The rate of actual telephone growth is found in Graph 2. The approximate numbers of telephones for those years are as follows:

Year	Number of Telephones
1899	1,000,000
1900	1,355,000
1901	1,900,000
1902	2,371,000
1903	2,808,000

Use the overhead transparency (Graph 1) to discuss the students' projections. Plot some of their projections on the graph. Two curves are shown on the graph. One is the curve of the actual data. The other is the interpolated curve (best fit curve) from which the trend is extrapolated.

- Have the students compare their Graph 1 extrapolation with the actual growth shown on Graph 2. Instruct the students to take the data from Graph 2 and plot the *actual* growth in the number of telephones on

their Graph 1. A visual comparison of actual growth and predicted growth can be made. Discuss with the students some of the reasons why their predictions were either similar or different from what actually took place. (Note: The data point for year 1903 extends beyond Graph 1. Students may either wish to add an additional section to the graph or else simply draw the curve in the direction of that point.)

- Encourage students to do some additional research on the historical developments of the U.S. during this period. What political, social, economic and population factors could have contributed to the rapid increase in telephone usage at this time?
- Assign students to complete Graph 2, following the instructions in their guide. The approximate number of telephones for the years under consideration are as follows:

Year	Number of Telephones
1908	6,484,000
1910	7,635,000
1912	8,730,000
1914	10,046,000
1916	11,241,000
1918	12,078,000
1920	13,329,000
1930	20,202,000

Use Graph 2 overhead transparency to show the actual growth rate. Plot some of the students' projections on the transparency during discussions of their results.

- Assign students to complete Graph 3. Growth is exceedingly rapid at this time. Students should infer from the steepness of the curve that the data points (for the years under consideration) fall beyond the graph. The total number of miles of wire are as follows:

Year	Number of Miles of Wire
1902	4,900,000
1907	12,999,000

Show the Graph 3 overhead transparency during discussion of student projections.

- Assign students to complete Graph 4. The previous graphs, Graph 1 and 2, may provide some additional clues for the projection of the trend line. Again, the overhead transparency, Graph 4, will be useful when discussing student projections compared with the actual growth rate.

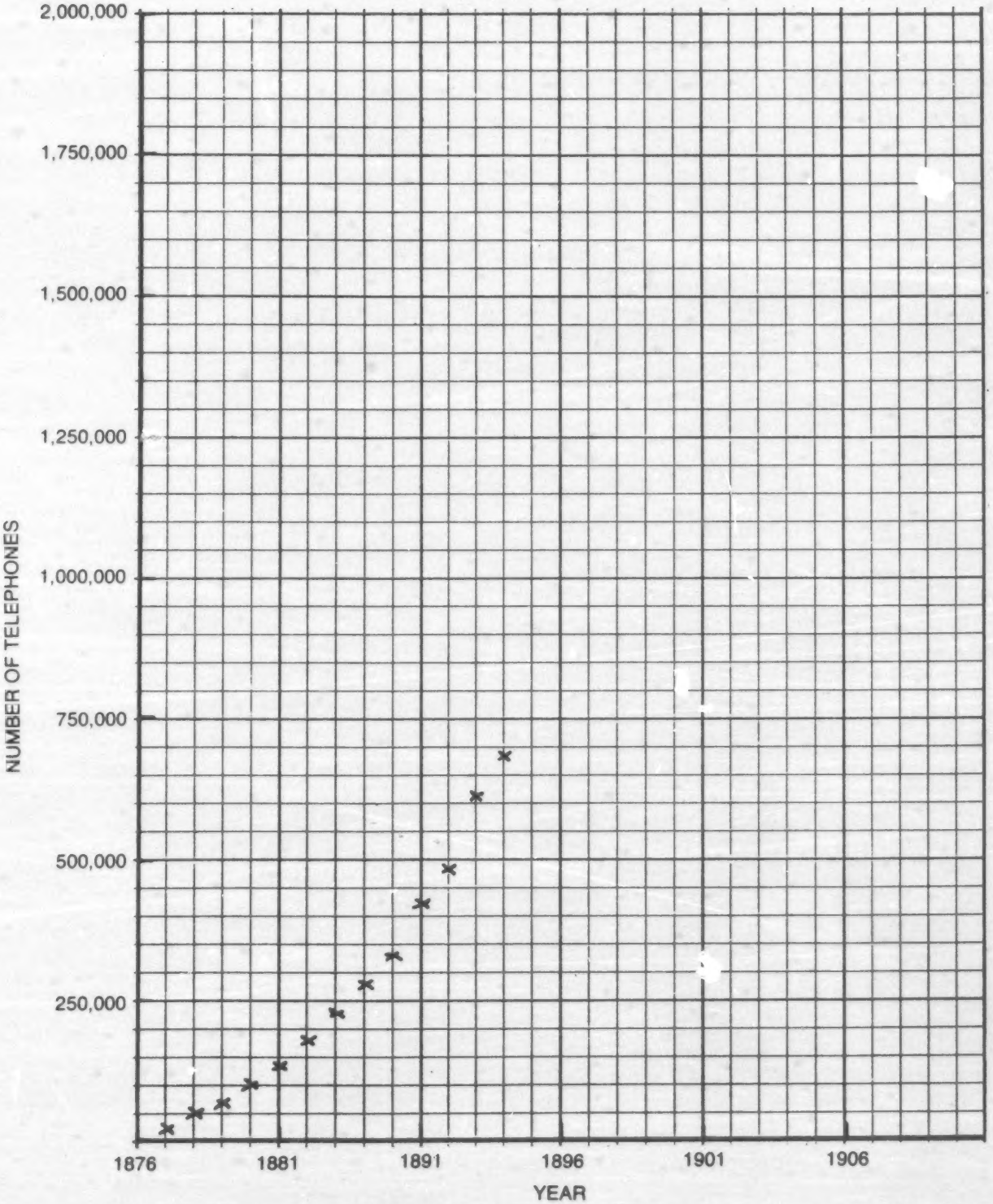
Year	Number of phones per 1,000 population
1896	5.7
1897	7.1
1898	9.2
1899	13.3
1900	17.6
1901	23.0
1902	29.7
1903	34.5
1904	40.4
1905	48.8
1906	51.2
1907	70.0
1908	72.4
1909	76.5
1910	82.0
1911	83.3
1912	90.7
1915	103.9
1920	123.9
1925	145.2
1976	500.0

Data Source:

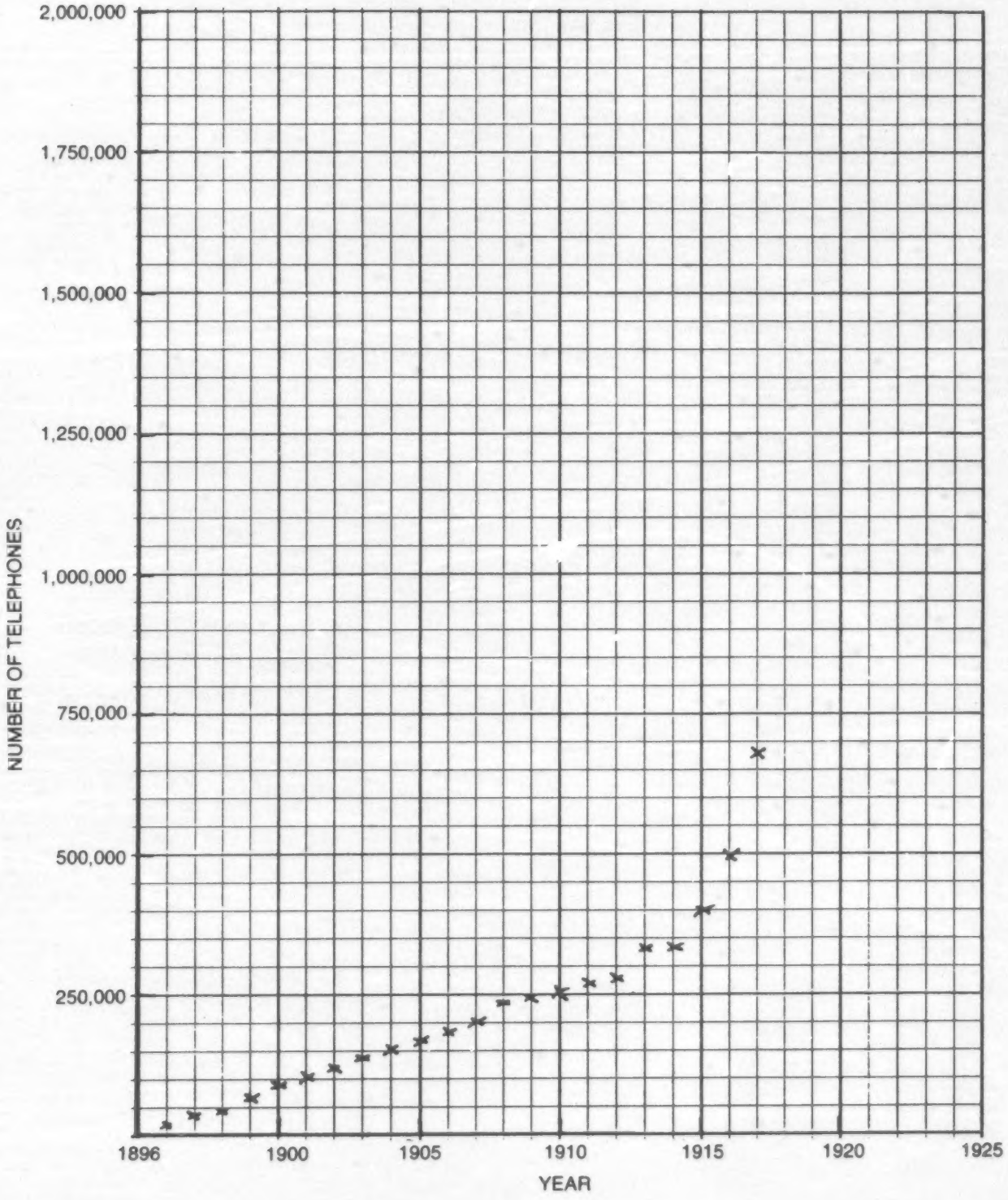
[1]U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1, Washington, D.C., 1975.

[2]U.S. Bureau of the Census, *Special Report: Telephones and Telegraphs*, Washington, D.C., 1902, 1912.

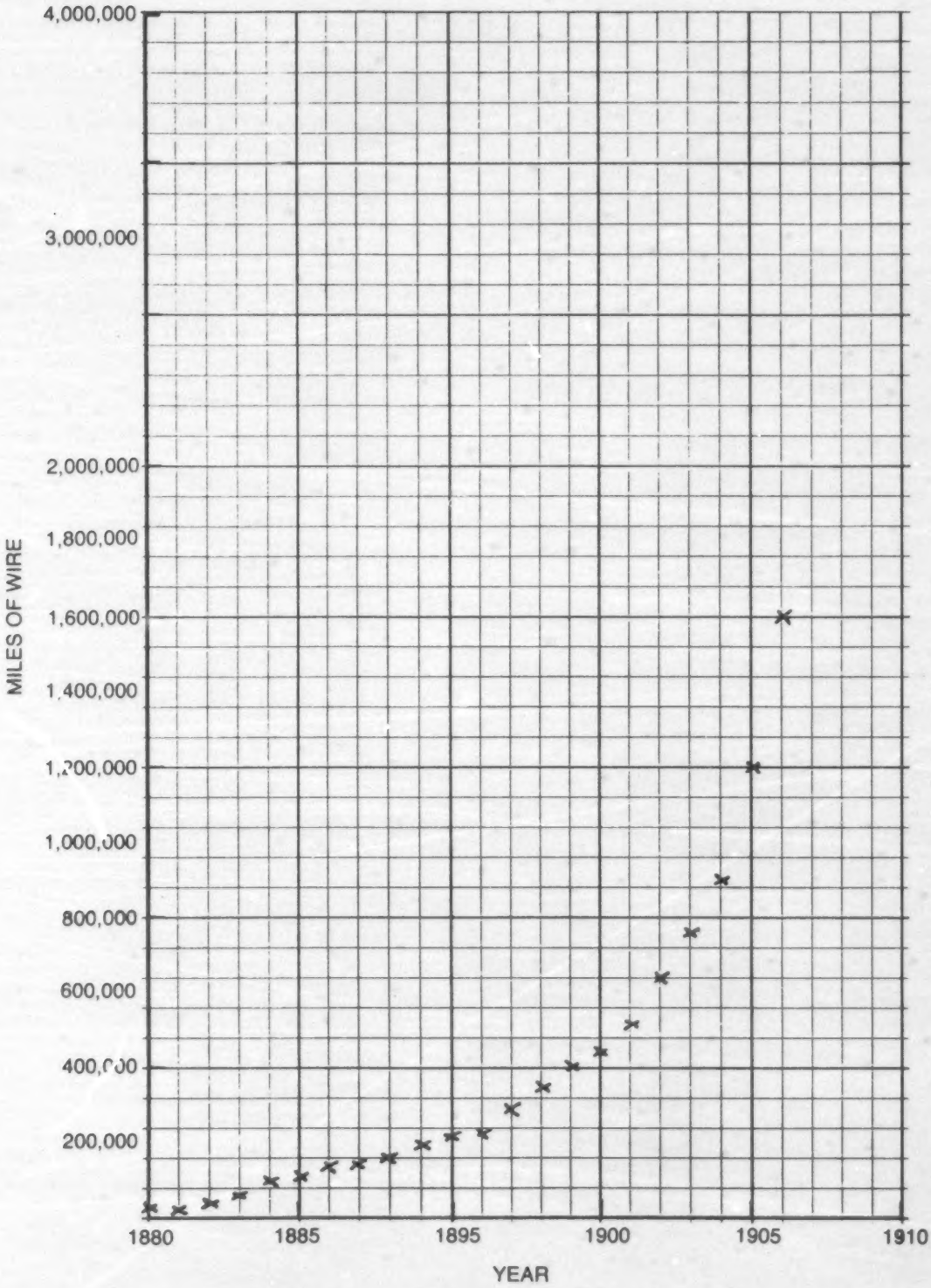
GRAPH 1: Telephones From 1876 to 1898



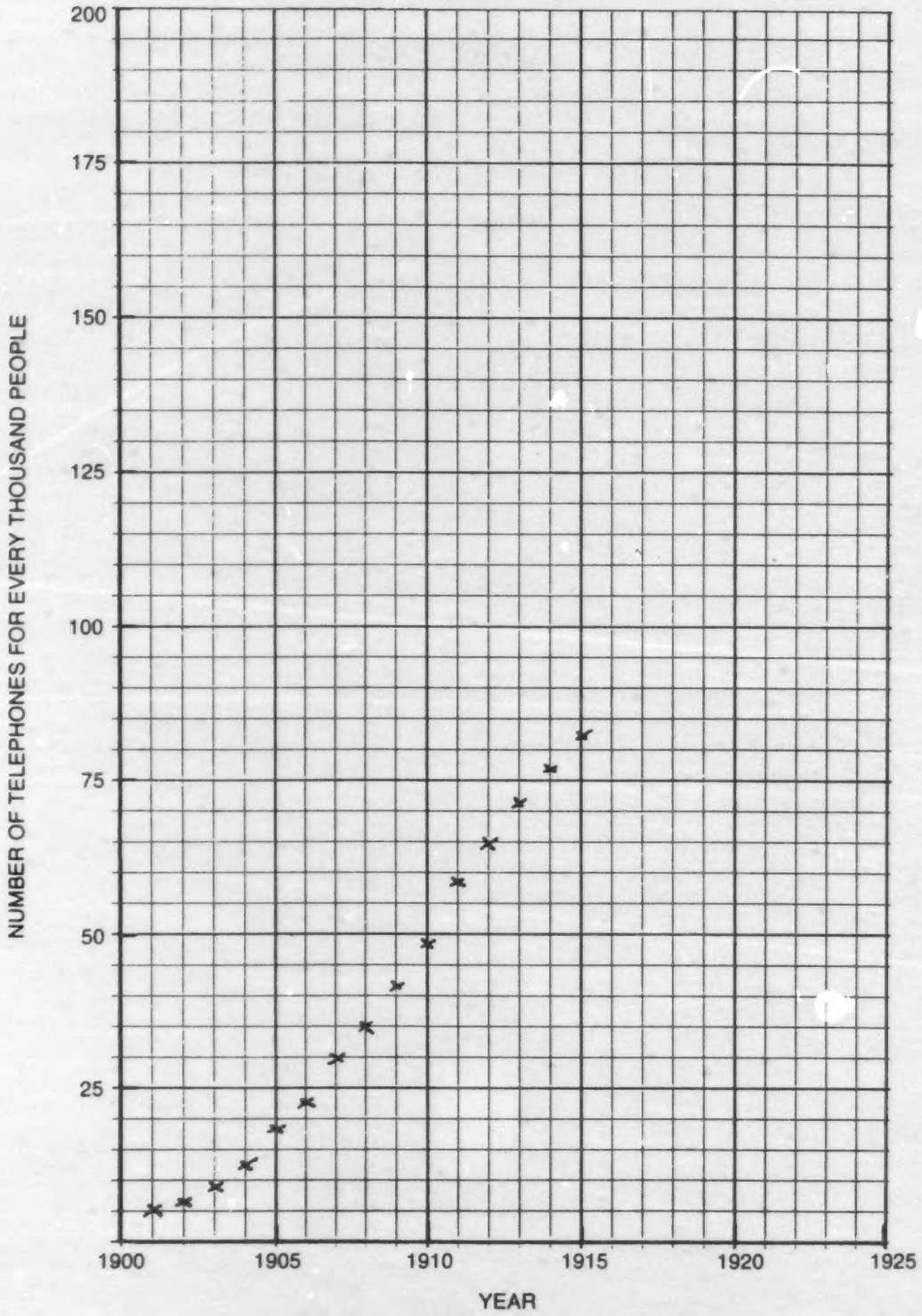
GRAPH 2: Telephones From 1876 to 1908



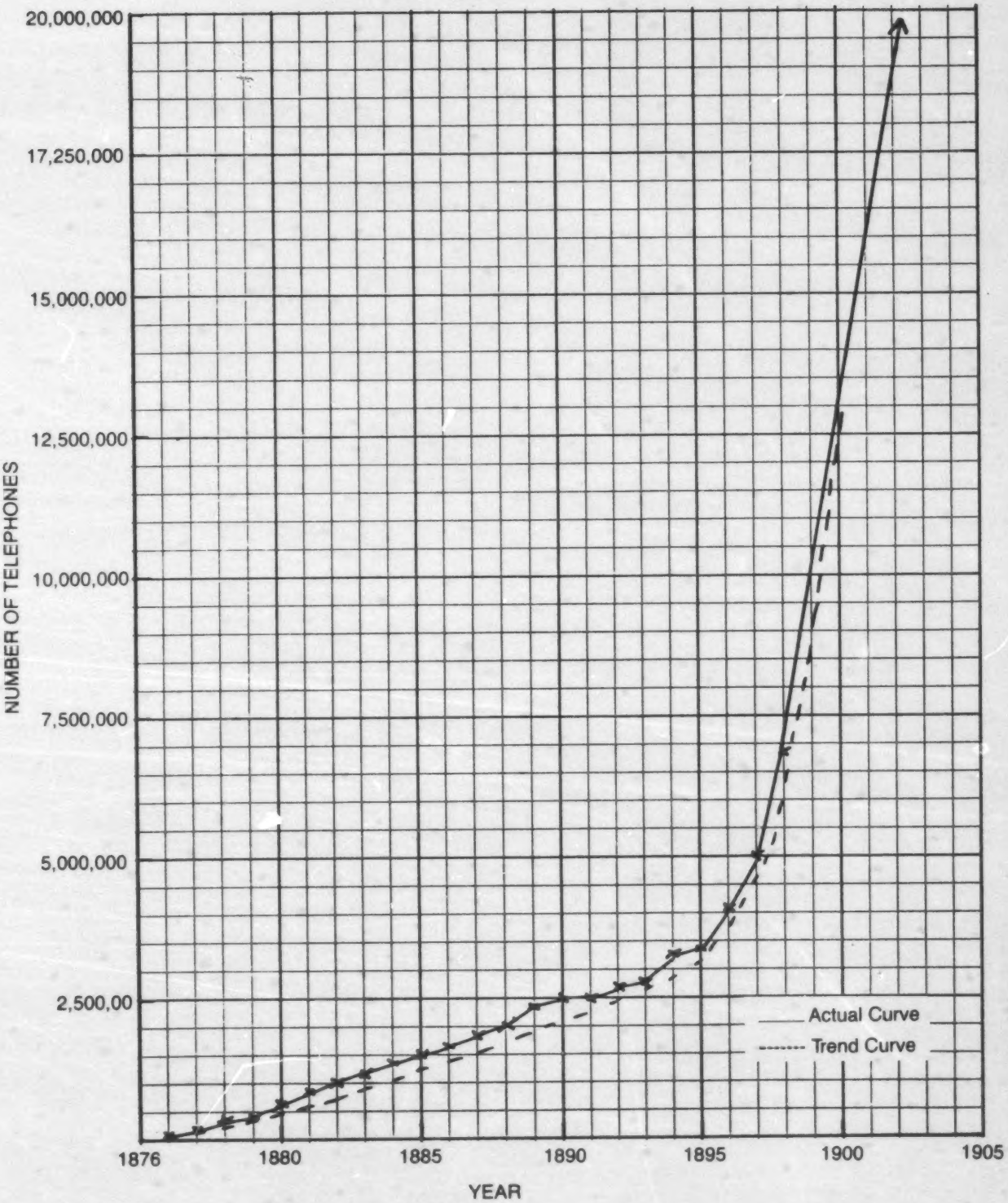
GRAPH 3: Miles of Wire 1880-1900



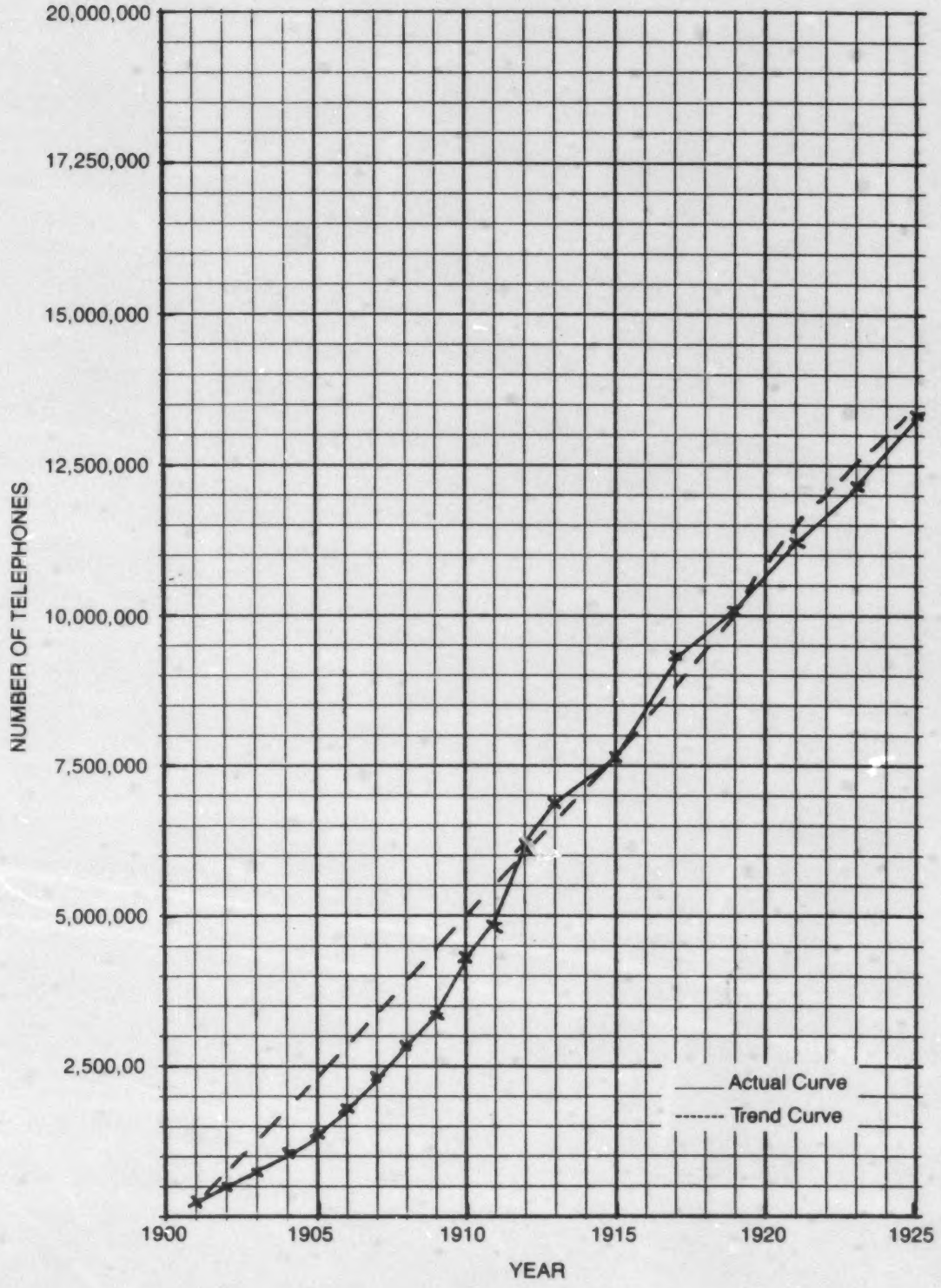
GRAPH 4: Number of Telephones for every 1,000 Persons, 1896-1910

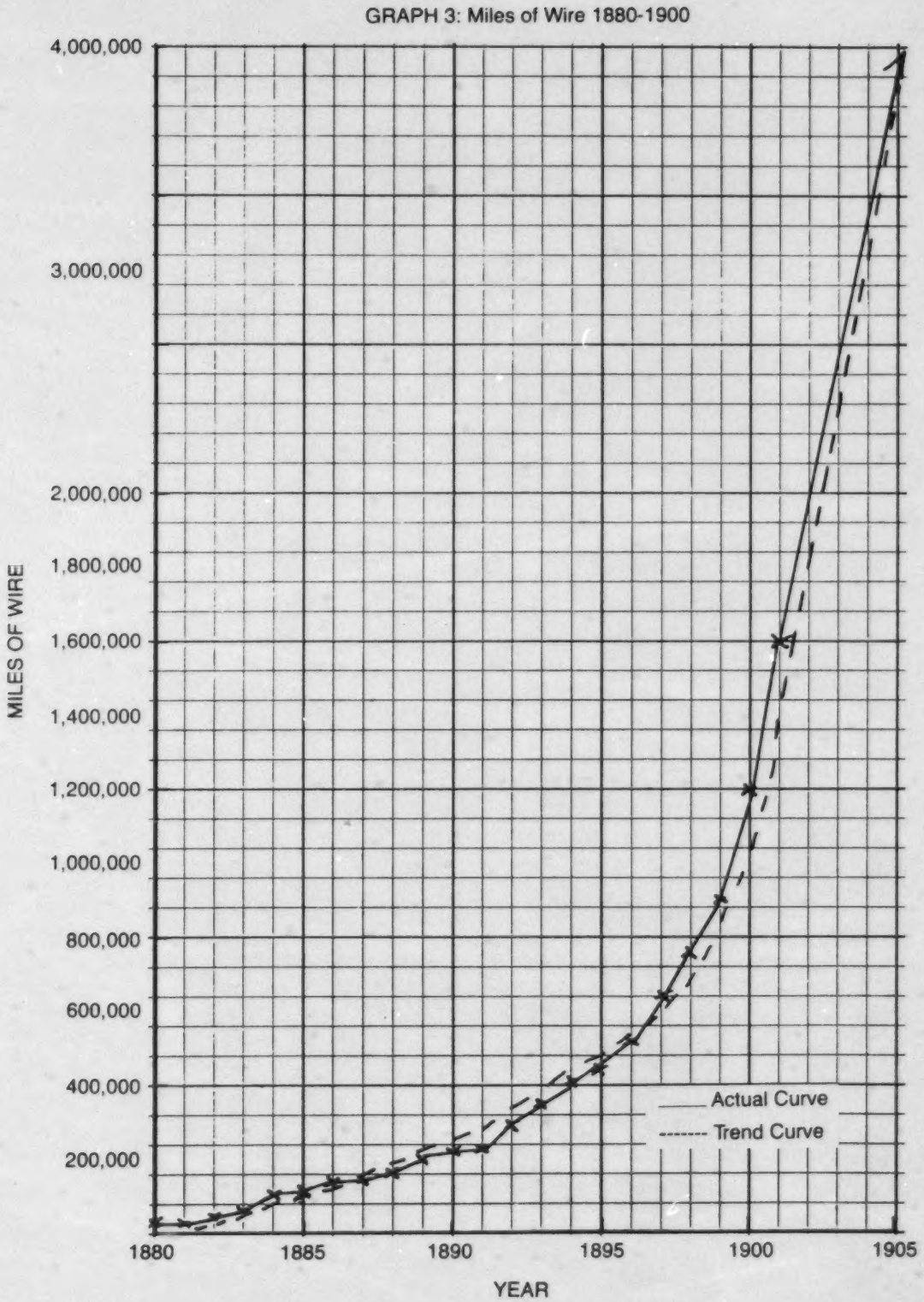


GRAPH 1: Telephones From 1876 to 1898

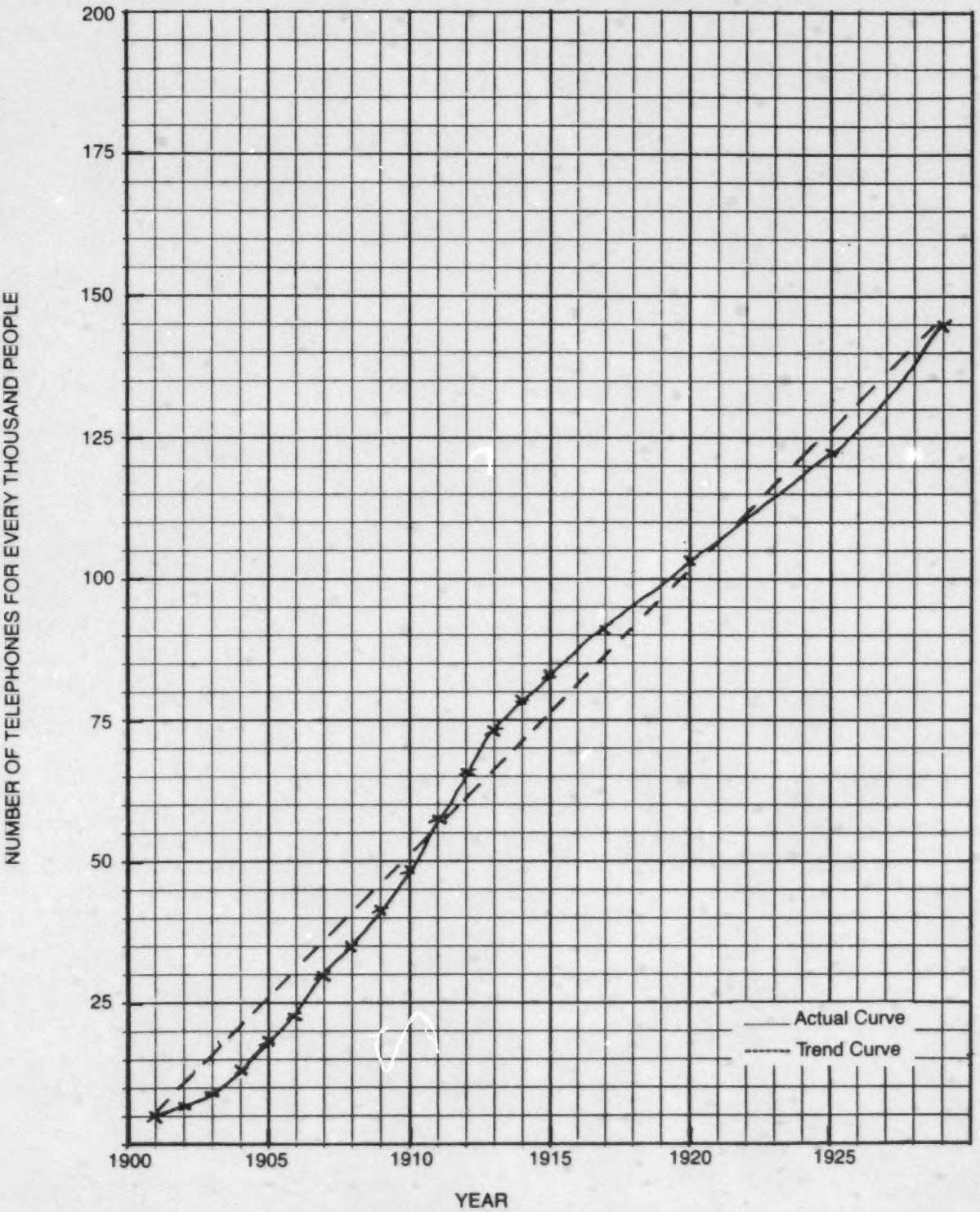


GRAPH 2: Telephones From 1876 to 1908




GRAPH 3: Miles of Wire 1880-1900
4,000,000
3,000,000
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
MILES OF WIRE
1880
1885
1890
1895
1900
1905
YEAR
Actual Curve
Trend Curve

GRAPH 4: Number of Telephones for every 1,000 Persons, 1896-1910



Activity 7: Who Will Get a Telephone? A Role Playing Exercise

- **Student Handout 8: Table To Aid in Decision Making**

Description

Students will role play a person living in the late 1800s and develop reasons for why this person should obtain the one available telephone.

Student Objectives

- To take the perspective of a person living 90 years ago.
- To consider the needs and concerns of another person.

Student Activities

- Eleven students will role play the applicants for a telephone.
- The remaining students will serve as the judges or decision making panel.

Procedures and Suggestions

- The widespread availability of telephones in the U.S. make this situation difficult for us to comprehend. However, analogies can be drawn to other situations where a product is scarce and a decision must be made regarding its distribution. Also, another point to be illustrated is that in the early days of telephone communications the telephone was not yet viewed as necessary. People had to recognize it as being helpful in the accomplishment of their daily activities as well as to weigh the economic feasibility of the major investment (e.g., the high yearly subscription rates). In addition, the degree to which the telephone was useful depended on the interconnection capabilities of the local exchanges (e.g., Who can one call?). In isolated rural communities the telephone was, in the beginning, primarily a neighborhood communications system whereas in the cities and industrial communities, the telephone served to reduce the expenditure of human energy in a wide variety of activities and tasks.
- Assign or have eleven students select one of the following roles:

Urban Community	Rural Community
1. Owner of a vegetable warehouse	6. Farmer
2. Scientific researcher	7. Newspaper editor
3. Fire chief	8. Butcher
4. Housewife	9. Sheriff
5. Worker in weaving mill	10. Student
	11. Tailor's apprentice

Allow some time for students to prepare their role presentation (i.e., about a day before their presentation is made). Each presentation should be no longer than five minutes.

- The remainder of the class will serve as the panel of judges. Each judge is allowed to ask each of the role players one question.
- Distribute copies of *Table to Aid in Decision-Making* for judges to fill out during the presentation.
- The scores will be used to help the judges decide who should receive the telephone. However, remind the student judges that those categories or factors listed are only four considerations out of many. The students may find other important factors that need to be considered. Also, each of the four factors are given the same weighting; yet it is possible that some factors should be weighted more heavily than others. The difficulty in attempting to *quantify* a decision should be pointed out to the students. This is particularly significant in light of the increasing number of decisions that are made today through the use of computers that, in turn, depend on certain established objective criteria, such as in credit ratings, college admission, automobile insurance rates, etc.
- In some cases, the judges may find that the person who receives the highest score may not necessarily be the person whom they feel has the greater need for a telephone.
- Have each judge submit his/her secret ballot, a piece of paper on which the title of *one* person is written. Tally the votes and announce the title of the person receiving the highest number of votes.
- At this point determine if the judges agree with the selection. If not, inquire as to their reasons for disagreement and what criteria they used in making their judgments. How might they wish to change the scoring system? Was their selection representative of the population who were among the first telephone users? What values were held to be of higher priority by the judges in making the selection?

Activity 7: Who Will Get a Telephone?

TABLE TO AID IN DECISION MAKING

Title	Number of Calls Made	Personal Need of Phone	Business Need of Phone	Will Calls Benefit Others	Total Score
1. Vegetable Warehouser					
2. Scientist					
3. Fire Chief					
4. Housewife					
5. Worker					
6. Farmer					
7. Newspaper Editor					
8. Butcher					
9. Sheriff					
10. Student					
11. Tailor's Apprentice					

Under each of the headings, determine the importance of the telephone to each of the persons listed. A one (1) to five (5) scoring scale will be used for each category.

1 = least (number, need, benefit)
2 = lesser (number, need, benefit)
3 = moderate (number, need, benefit)
4 = great (number, need, benefit)
5 = greatest (number, need, benefit)

Each person shall receive a score from one (1) to five (5) for each of the four categories. When all the role presentations have been made and the table has been completed, add across the table to obtain a total score for each of the eleven persons. The higher scores would indicate the persons who have most need of a telephone.

Guide To Section II:
The Computer

Overview

In the preceding section, students had the opportunity to explore some of the many changes brought about by the telephone communications. They also used some futures forecasting techniques to demonstrate how such techniques could be employed in decision making. However, in the preceding case, hindsight was a significant advantage. In this section the students will have to rely on their own interpretations of future impacts of computer technology.

It is hoped from the previous exercise the students will have gained a degree of awareness of the multiple effects and the major changes in lifestyle brought about by the availability of direct voice communications over long distances. It involved changes in how we conduct business, how we maintain social interactions, how we gain and transmit information, how we control or direct activities from distant locations, etc.

The application of computer technology may bring about other types of changes. Some of these changes can be predicted with greater confidence than others. Some other changes may be totally unforeseen. The students will now consider a few of the possible choices and the implications and consequences of new developments in computers and communications.

Reading 4: The History of the Computer

Summary

This reading introduces the technical development of the computer. Additionally, it points out how our information needs and task requirements stimulated the search and development of computer systems with increased capabilities.

Student Objectives

- To gain an understanding of computer technology from an historical perspective.
- To gain a knowledge of computer applications.

Comments and Suggestions

- To help students become aware of how computers partake in the many facets of our daily lives, have students bring in examples illustrating an activity where computers intervened. These items could be put together into an interesting classroom wall montage. Some examples might include:

  address labels (magazines, circulars)
  school schedules
  newspapers typeset by computers
  "personalized" form letters
  labels on grocery items
  tickets
  print outs
  punch cards
  checks
  merchandise price tags

- The above examples of computer activity can be categorized in terms of activity (e.g., accounting and billing, mailing, information storage, inventorying, scheduling, etc.). Discuss with the class those activities and how computers help to conserve human energy and time. Have them also consider some of the possible and potential problems that could arise. How might they be resolved? Have they or their parents ever encountered computer errors? What might have been the source of that error?

Activity 8: Scenario: A Computer in Your Life

Description

The "computer on a chip" has revolutionized the world of computing and communications. Microcomputers are now found in the average home in many different forms, and their future applications offer exciting changes in the way we live and work. In this activity students will describe in a scenario ways they might use home computers. A sample scenario is included in the introduction.

Student Objectives

- To project lifestyle changes that result from the use of the computer.
- To develop a scenario forecasting how they will personally use and benefit from new computer applications.

Student Activities

- Each student will write a one or two page scenario using one of the scenario formats suggested.
- The completed scenarios are then read to the class and discussed.

Procedures and Suggestions

- New computer applications seem to appear on the scene daily. It may thus be useful for the students to survey some of the new products on the market before writing their scenario. News magazines, ads, and computer hobbiest magazines are good sources for innovative ideas.
- Having the students share their scenario is an important aspect of this exercise. In this way they are exposed to a wider range of potential uses. Also, they

can begin to see differences in personal preferences and opinions about computers.

- The students might form small groups to read their scenarios to one another. Afterwards, they summarize their computer uses in the form of a list for presentation to the entire class.
- The following are some suggested questions for class discussion.
  - — What were some of the major changes in lifestyle?
  - — Were the tasks performed by the computer more of a necessity or a luxury?
  - — What computer applications identified are currently available? Which ones were not?
  - — What new developments/inventions are needed before the forecast becomes a reality?

Reading 5: Computers + Communications = Compunications

Summary

This reading draws the analogy between the development of telephony and computer communications. Both involve a system of interconnecting networks. While numerous computer applications have been forecasted, the extent to which these services will become available on a widespread, low-cost basis will depend upon the development of interconnections. How the networks are established raises a number of economic, political, social and philosophical questions.

Student Objectives

- To gain an understanding that computer networks are a fusion of two lines of development — computer technology and communications technology.
- To gain an understanding of some of the problems inherent in the development of computer information systems and communication via computers.

Comments and Suggestions

- Since the concepts presented in this reading are complex, additional class discussion is recommended. To help students understand the concept of computer networks, trace the processes of data input and retrieval of computer systems familiar to the students. These systems might include those used in
  - banking
  - grocery check outs
  - airline ticket sales
  - hotel reservations
  - student's class schedules
- The network might best be illustrated in the form of a diagram.
- Have the students find out how computer terminals are currently connected to central terminals.

Activity 9: What Are Your Computer Forecasts — A Delphi Survey

- **Student Handout 9:** What are Your Computer Forecasts

Overview

Students will conduct two rounds of the Delphi Survey which seeks their opinions on computer applications. They will forecast the occurrence of an event and indicate the desirability of that event. The results of this survey will reflect the class' intuitive estimation of computer development based on students' knowledge of computers.

Student Objectives

- To identify their opinions regarding computer developments and lifestyle changes
- To examine their own reasons for making particular choices

Procedures and Suggestions

Round one

- Distribute a copy of the survey to each student and review the procedure outlined in the Student's Guide. Remind the students to work individually.
- For each statement item students are to
  1) estimate the time the event will occur
  2) indicate the desirability of the event
  3) list some possible effects that may take place
  4) provide a reason for their decision/conclusion
- As in the previous Delphi, a panel moderator will collect the completed survey forms and summarize the results.
  1) the responses are tabulated on a new survey

form. This form should be labelled *Summary Form, Delphi, Round One*.

2) Total the number of responses for each column and determine the point of majority consensus. That is, did one half or more of the panel members select the same time interval?

Example:

Between 1980-1990	Between 1990-2000	Between 2000-2010	Beyond 2010
~~++++~~ ③	~~++++~~ II ⑦	~~++++ ++++ ++++~~ I ⑬	II ②

The majority, in the above example, indicated that the event would most likely occur between the years 2000 and 2010.

3) For the written responses, list some of the effects/reasons most frequently cited.

4) Present the *summary* for the class to examine.

Round Two

- Distribute a second copy of the survey for the students to complete.
- If the students decide to change the response they made in the first round, they should also indicate the reason(s) for the change.
- The completed forms are again collected and summarized in the same manner as previously described, in *Summary Form, Delphi, Round Two*.

Discussion of Results

- The results of the two rounds are displayed for the class to compare. The results may either be projected on a screen or copied on the chalkboard.
- Some suggested discussion questions are found in the Student's Guide.
- The results of Round Two can be translated into a narrative which describes the panel's forecast of computer developments and subsequent changes.

Reading 6: The Computer: Friend or Foe?

Summary

This reading briefly touches upon some of the concerns and criticisms of computer applications. A number of critics fear the loss of personal privacy, the effects of computer errors and the dehumanizing aspects of machines performing our work or making decisions.

Student Objectives

- To gain an awareness of possible adverse effects of computer applications.
- To recognize the need for safeguards in computer usage.

Comments and Suggestions

- After students have completed this reading, they may wish to explore the benefits and risks associated with a particular application in greater detail. The "brainstorming" technique can be effectively used in this instance to elicit student ideas. Take, for example, an application such as "shopping by computer."
  - — Divide the class into two groups. One group will present the advantages; the other group, the disadvantages.
  - — The groups will take their turn alternately; a member from one group will present one idea, then a member of the other group will present another idea.
  - — Continue the process until each group member has offered an idea and all ideas appear to be exhausted.
  - — The ideas should be listed on the board and then evaluated at the end of the brainstorming session.

Delphi Survey 2: What Are Your Computer Forecasts?

	In Your Opinion How Desirable is This?				When Do You Think This Will Occur?						
	very desirable	desirable	neutral	not desirable	1980 - 1990	1990 - 2000	2000 - 2100	beyond 2100	never	**What Are Some of the Effects?**	**Explain Why You Came to This Conclusion**
ADVANCES IN COMPUTERS											
1. Computers will understand human speech & respond to spoken instructions.											
2. Computers will learn from experience & correct their own mistakes.											
3. Computers will perform thinking and planning tasks.											
4. Computers will operate motor vehicles, trains, subways & ships without need of human operators.											
FUTURE CHANGES											
1. Every household will have a computer.											
2. Nearly everyone will know how to program a computer.											
3. Most courses in schools will be taught by computers.											
4. We will use computers to decide where to live, who to marry, what job to take, how to spend money.											
5. If one wants information about another person, one can obtain it from a computer data bank.											
6. With computerized banking & exchange of money electronically, cash will not be needed.											
7. A majority of people will spend most of the day at home.											

Activity 10: Exploring Computer Effects — The Futures Wheel

Overview

The Futures Wheel is a technique used to explore the consequences of an idea, trend or decision. The effects are displayed in a graphic style which permits one to examine multiple interactions and "spin-offs." The central idea/trend is entered in a circle in the center of the paper. Spokes extend from the central circle and end with a circle in which is entered a 1st order effect. The process is repeated with 2nd order effects radiating from the 1st; 3rd from the 2nd and so on.

Student Objective

- To study the consequences/effects of an idea/trend

Student Activities

- Students working in small groups will select one of the ideas suggested or use one of their own to complete a Futures Wheel.

Procedures and Suggestions

- Review with the students the instructions and example shown in the Student's Guide.
- If available, have the students use large sheets of paper (i.e, newsprint). This will permit the members of the group to work on the wheel simultaneously.

Reading 7: Computers by the Numbers

Summary

This reading summarizes the technological changes in computers during the past twenty years that have resulted in lower costs and greater availability.

Student Objectives

- To examine some data on the growth of computer usage and factors contributing to the growth.
- To gain an awareness of some of the implications of increased computer usage.

Comments and Suggestions

- Have students bring in articles or advertisements for mini-computers currently on the market. Consider to whom these ads are directed and suggested applications.
- Students may also wish to compare the price and capacity of different computers.

Activity 11: Forecasting Computer Trends: An Exercise in Trend Analysis

- **Materials needed:** graph paper

Overview

Students will graph data provided and use trend extrapolation techniques to make forecasts regarding numbers of computers, storage size, cost and computing speed.

Student Objectives

- To examine trends in computer development using the trend extrapolation technique.
- To gain experience in graphing
- To compare data on numbers of computers, storage size, computing cost and computing speed.
- To consider the implications of future computer development.

Student Activities

- Students will construct four graphs using the data given.
- They will determine the trend curve for each graph and extrapolate that curve to the year 1990.

Procedures and Suggestions

- It may be helpful to review with the students graphing procedures the trend extrapolation technique. For example, Graph 1 might be completed as a class exercise while the subsequent graphs are completed individually.
- Computer technology has made ten-fold or one-hundred fold leaps in a few short years. Graphing the data on a logarithmic scale would, of course, be much easier if students have had experience with higher mathematics. However, this not being the case, the more conventional method will have to suffice. It is, therefore, necessary to make sure that the students construct a scale appropriate for the data (especially for Graph 4).
- After completion of each graph, have the students compare their forecasts. Note the differences and the possible reasons for the differences. Have students consider whether their forecasts are possible. (When a trend curve is extended the curve might approach zero or infinity. However, this might not be a realistic situation due to physical or economic limitations.

Activity 12: What are Your Future Visions? A Communications Scenario

Overview

In this scenario writing activity students will write about a future possibility in communications. This scenario should incorporate some of the information and trends discussed in the readings and activities. In addition to creating an imaginative or innovative forecast, students should also reflect on the trade-offs involved and the impacts and consequences of that possible future.

Student Objectives

- To consider a future possibility and to provide a detailed account of that possibility in the form of a scenario.
- To synthesize prior information for inclusion in the scenario.
- To consider present trends and their implication for the future.

Student Activities

- Individually or in small groups students will write a communications scenario based on their knowledge of computer applications, teleprocessing and telecommunications. The scenario should reflect their personal preference regarding computer usage and include a critical analysis of the implications of their forecast.
- The completed scenario should be shared with the entire class. This will perhaps stimulate further discussions on computers and future communications.

Procedures and Suggestions

- Review with the students the main characteristics of scenario writing. Remind them that a good way to start is to examine a current trend and follow one or more alternative directions suggested by the trend (e.g., the trend of decreasing costs of home computers, the trend towards simplifying computer programming; the trend towards greater use of communications satellites.)
- Encourage the students to be creative and stretch their imaginations. The scenario need not be longer than two to three pages, but students should include supportive information about a future time. (i.e., What decisions and new developments are prerequisite for the future they envision?)

Some Concluding Remarks

In this module the students have been briefly exposed to some of the techniques used by future forecasters. Using these techniques, we can perhaps catch glimpses of possible futures. However, the more valuable lesson students can gain is the awareness that forecasts, even by experts, should be considered as one of many possible alternatives. Forecasts are perhaps most useful to alert one to possible consequences or impacts.

There is no technique which predicts the future with absolute certainty. For example, weather forecasting which now employs some of the most sophisticated instrumentation such as satellite monitoring, radar, etc. can make accurate forecasts only within hours of the event for a given city.

Another example is the elaborate and complex computer simulation model of global trends developed for the Club of Rome project by Professor Dennis Meadows and his team, and presented in the book *Limits to Growth*. Projecting population, economic, industrial, resource pollution, etc. growth since 1900, the MIT team predicted an inevitable crisis in our world system with famine, disease and total collapse of industry. Their pessimistic prediction calls for a halt in economic growth by 1975 in order to head off disaster. Their suggested solution has not been heeded and, in fact, has been vigorously challenged by critics. Moreover, we have passed some of the years when certain of their dislocations predicted, have not come to fruition. What this points out is that forecasts are only as good as the data selected and the assumptions one makes. It is, therefore, necessary to question the perspective taken by forecasters in making certain assumptions, the interacting factors that are viewed to be important, and how adequately they have weighed the variables.

Our hope is that the students who have worked with some of the forecasting methodologies in these materials have gained some insights. Unexpected new developments can lead to uncharted directions, but these directions will be largely determined by many different decisions, based on what is valued and considered desirable. In their future decision-making capacity, perhaps our students will be more able to deal with the multiplicity of variables with increased sensitivity to the value issues that are an integral part of each decision.

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APPENDIX

Stages of Moral Development

PRECONVENTIONAL LEVEL

At this level the child is responsive to cultural rules and labels of good and bad, right and wrong, but interprets the labels in terms of either the physical or the hedonistic consequences of action (punishment, reward, exchange of favors) or in terms of the physical power of those who enunciate the rules and labels. The level is divided into the following two stages:

STAGE 1

The punishment and obedience orientation. The physical consequences of action determine its goodness or badness regardless of the human meaning or value of these consequences. Avoidance of punishment and unquestioning deference to power are valued in their own right, not in terms of respect for an underlying moral order supported by punishment and authority (the latter being stage 4).

STAGE 2

The instrumental relativist orientation. Right action consists of that which instumentally satisifies one's own needs and occasionally the needs of others. Human relations are viewed in terms as those of the market place. Elements of fairness, of reciprocity, and of equal sharing are present, but they are always interpreted in a physical, pragmatic way. Reciprocity is a matter of "you scratch my back and I'll scratch yours," not of loyalty, gratitude, or justice.

CONVENTIONAL LEVEL

At this level, maintaining the expectations of the individual's family, group or nation is perceived as valuable in its own right, regardless of immediate and obvious consequences. The attitude is not only one of conformity to personal expectations and social order but of loyalty to it, of actively maintaining, supporting, and justifying the order, and of identifying with the persons or group involved in it. At this level, there are the following two stages.

STAGE 3

The interpersonal concordance of "good boy - nice girl" orientation. Good behavior is that which pleases or helps others and is approved by them. There is much conformity to stereotypical images of what is majority or "natural" behavior. Behavior is frequently judged by intention—"he means well" becomes important for the first time. One earns approval by being "nice."

STAGE 4

The law and order orientation. There is orientation toward authority, fixed rules, and the maintenance of social order. Right behavior consists of doing one's duty, showing respect for authority, and maintaining the given social order for its own sake.

POSTCONVENTIONAL OR PRINCIPLED LEVEL

At this level, there is a clear effort to define moral values and principles which have validity and application apart from the authority of the groups or persons holding these principles and apart from the individual's own identification with these groups. This level again has two stages, which are as follows:

STAGE 5

The social-contract legalistic orientation, generally with utilitarian overtones. Right action tends to be defined in terms of general individual rights and standards which have been critically examined and agreed upon by the whole society. There is a clear awareness of the relativism of personal values and opinions and a corresponding emphasis upon procedural rules for reaching consensus. Aside from what is constitutionally and democratically agreed upon, the right is a matter of personal "values" and "opinion." The result is an emphasis upon the possibility of changing law in terms of rational considerations of social utility (rather than freezing it in terms of stage 4 "law and order"). Outside the legal realm, free agreement and contract is the binding element of obligations.

STAGE 6

The universal ethical principle orientation. Right is defined by the decision of conscience in accord with self-chosen ethical principles appealing to logical comprehensiveness, universality, and consistency. These principles are abstract and ethical (the Golden Rule, the categorical imperative); they are not concrete moral rules like the Ten Commandments. Instead, these are universal principles of justice, of the reciprocity and equality of human rights, and of respect for the dignity of human beings as individual persons.

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